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ABSTRACT

Descriptions of representative nonconventional information systems in use today are given in order to provide managers, management analysts, supervisors, and others with ideas as to how they might improve the dissemination, storage, and retrieval of information in their offices. No attempt was made to evaluate the relative merits of the systems described or to include all the information retrieval systems in use within the Government today. Three general principles were followed in selecting the systems to be included: (1) to cover a representation of the more significant nonconventional methods and equipment in use today, from the simplest to the most complex; (2) to provide a wide spectrum of the types of work activities where nonconventional information retrieval methods and equipment are being successfully employed and (3) to limit the examples to operating systems using equipment that is generally available. There are many approaches one might take in solving any given information retrieval problem. The broader your knowledge of systems, the more likely you are to find the best answer to your information retrieval problem. (Author/NH)

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FPMR 101—11.3

RECORDS MANAGEMENT HANDBOOK

Managing Information Retrieval

INFORMATION RETRIEVAL SYSTEMS

ED052809

LI od2 955

1970

GENERAL SERVICES ADMINISTRATION
NATIONAL ARCHIVES AND RECORDS SERVICE
OFFICE OF RECORDS MANAGEMENT

[illegible]
703-321-737

RECORDS MANAGEMENT HANDBOOKS are developed by the National Archives and Records Service as technical guides to reducing and simplifying paperwork.

RECORDS MANAGEMENT HANDBOOKS:

Managing correspondence: *Plain Letters*	1955	47 p.
Managing correspondence: *Form Letters*	1954	33 p.
Managing correspondence: *Guide Letters*	1953	23 p.
Managing directives: *Communicating Policy and Procedure*	1967	62 p.
Managing forms: *Forms Analysis*	1960	62 p.
Managing forms: *Forms Design*	1960	89 p.
Managing forms: *Forms Management*	1969	34 p.
Managing mail: *Agency Mail Operations*	1957	47 p.
Managing current files: *Files Operations*	1964	76 p.
Managing current files: *File Stations*	1967	62 p.
Managing current files: *Subject Filing*	1966	40 p.
Managing information retrieval: *Information Retrieval Systems*	1970	150 p.
Managing information retrieval: *Microform Retrieval Equipment Guide*	1970	64 p.
Managing emergency preparedness files: *Federal Vital Records Program*	1965	16 p.
Managing noncurrent files: *Applying Records Schedules*	1961	23 p.
Managing noncurrent files: *Federal Records Centers*	1967	39 p.
Mechanizing paperwork: *Source Data Automation*	1965	76 p.
Mechanizing paperwork: *Source Data Automation Equipment Guide*	1970	122 p.
Mechanizing paperwork: *Source Data Automation Systems*	1968	83 p.
General: *Bibliography for Records Managers*	1965	38 p.
General: *Copying Equipment*	1969	32 p.

ED052809

FOREWORD

The methods and equipment used in most offices for storing and retrieving information have changed insignificantly in the past 50 years and many of these systems are still adequate today. However, the situation is rapidly changing and has already become a serious problem in some offices. The information explosion that began with World War II and the increased complexity in Government operations make it necessary for many managers to consider improved methods and equipment. Fortunately, because of pioneering efforts in the scientific and engineering communities and developments in records miniaturization, computer technology, and electronic communications, today's manager has new answers to his information retrieval problems. This handbook contains descriptions of representative nonconventional systems in use today, with a view toward providing managers, management analysts, supervisors, and others with ideas as to how they might improve the dissemination, storage, and retrieval of information in their offices.

Although this handbook is issued as one of a series of Records Management Handbooks produced by the National Archives and Records Service, General Services Administration (GSA), the United States Air Force shared in its development. It was produced under a contract jointly funded and administered by the Air Force and GSA.

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INTRODUCTION

Purpose

The purpose of this handbook is simply to describe selected information retrieval systems in use today, so that those seeking information on the subject may learn what others are doing to solve their information retrieval problems. No attempt has been made to evaluate the relative merits of the systems described or to include all of the information retrieval systems in use within the Government today.

Three general principles were followed in selecting the systems to be included in the handbook:

- To cover, as far as possible, a representation of the more significant nonconventional methods and equipment in use today, from the simplest to the most complex.
- To provide a wide spectrum of the types of work activities where nonconventional information retrieval methods and equipment are being successfully employed.
- To limit the examples to operating systems, or those in the process of implementation, using equipment that is generally available.

This handbook clearly illustrates that there are many approaches one might take in solving any given information retrieval problem. Some of the systems described may at first seem too expensive for the situation you have in mind. This may not prove to be the case, since it may be possible to share the costs of development and equipment with some other group having a similar need or to have the work performed by a service bureau. On the other hand, some of the systems in the handbook may seem overly simple, and there may be a temptation to underrate their value.

The right choice in any situation can be made only after a careful cost-benefits study has been conducted—a study that compares the best suited conventional methods for accomplishing the task against the best suited nonconventional information retrieval methods and equipment. Hence, the broader your knowledge of systems, the more likely you are to find the best answer to your information retrieval problem.

Related Handbooks and Workshops

The National Archives and Records Service has three handbooks that provide guidance in the development and operation of conventional systems: *Subject Filing*, *Files Operations*, and *File Stations*. There is also available a training workshop, "Files Improvement."

In addition to this handbook on information retrieval systems, two others are being developed. The first is titled *Microform Retrieval Equipment Guide*, and the second is *Information Retrieval*. A workshop, "Office Information Retrieval" is also available. The materials for this workshop and the one titled "Files Improvement" may be purchased by individual agencies who wish to conduct workshops for their own personnel; or, in some situations, workshops may be conducted at an agency location by National Archives and Records Service personnel. In addition, agency personnel may attend the regularly scheduled workshop sessions conducted by the National Archives and Records Service in Washington, D.C., and by the General Services Administration regional offices.

If the system selected employs an electronic computer, one of the major costs and possibly the most serious problem will be in converting the input data to a machine-language format. The Records Management Handbook *Source Data Automation* and the workshop of the same title provide guidance in this area. There is also available a General Services Administration Handbook titled *Source Data Automation Equipment Guide*.

IDENTIFICATION OF SYSTEMS BY METHOD AND EQUIPMENT CLASS

LIST OF SYSTEMS	PAGE NUMBER	METHOD AND EQUIPMENT CLASSES																			
		CLUE-WORD EXTRACT CARD	PERMUTED INDEX	COLUMNAR CARD	DUAL DICTIONARY	EDGE-NOTCHED CARD	OPTICAL COINCIDENCE	PUNCHED CARD	MISC. CARD SELECTORS	MICROFILM JACKET	MICROFICHE	MICROFILM STRIP	MICROFILM ROLL, MECHANIZED	MICROFILM ROLL, PHOTO-OPTICAL	MICROFILM CHIP, AUTOMATED	APERTURE CARD-PUNCHED	APERTURE CARD-EDGE-NOTCHED	MICROFILM, SUPERMINIATURE	VIDEO RECORDING	COMPUTER
Aerospace Information Dissemination	113										X										X
Aircraft Accident Analysis	14																				X
Aircraft Maintenance Manual, Distributing and Updating	145												X								
Allotment Disbursement Record	54												X								
Animal Inventory Management	125					X															
Automated Engineering Data Retrieval and Reproduction	32							X							X	X					
Automated Merchant Vessel Report (AMVER)	131																				X
Automated Name Search	122																				X
Automated Personnel	88																				X
Battelle Clue-Word Card	140	X																			
Battelle Dual Dictionary Index	143				X																
Beneficiary Information	82										X										
Building Space Information	34																				X
Census Age Search	20													X							
Computer Output Data Retrieval	137												X								
Congressional Information Network	107																				X
Correspondence Retrieval	42													X							
DDC Information Storage, Dissemination and Retrieval	75										X										X
Deficiency Identification	37																				X
Engineering Drawings Storage and Reproduction (with Color Overlays)	39															X					

ERIC (Educational Resources Information Center)	80																			
Failure Rate Data Dissemination (FARADA)	45										X									X
The Fosdic SS	17													X						X
Information Retrieval and SDI Current Awareness	98																			X
Information Storage and Retrieval for Patents (Ex)	26								X	X										X
JCS Records Retrieval	29						X													
Land Patent Control Document Index	93																X			
Legal Information Through Electronics (LITE)	57		X																	X
Machine Readable Catalog Dissemination (Project MARC)	110																			X
Meat Label Storage and Retrieval	8																X			
Medical Record Storage	78								X	X										
Microform Engineering Drawings Support	72																X			
Microform Personnel Record	60										X									
Miniaturized Management Reports Distribution	63												X							
Miniaturized Navy Catalog Data	48										X									
NASA/RECON Automated Reference	116		X								X									X
National Crime Information Center (NCIC)	104																			X
National Driver Register	128																			X
National Employee Account Card Holders	85												X							
National Marine Data Inventory (NAMDI)	119																			X
National Weather Records Center	23													X						X
Office Files Coordinate Index	66			X																
Personnel Skills Inventory	134						X													
Pesticide Label Control	11							X												
Public Works Drawings Retrieval	51																X			
RIRA-Legal Information	101		X								X									
SDI Current Awareness	96																			X
Technical Data Dissemination and Retrieval	69													X						
Video Tape Information Storage and Retrieval	91																		X	
ZIP Code Data Retrieval	148											X								

Figure 1

How to Use the Guide

General browsing. If you are looking for ideas on how you might improve information storage, retrieval, and dissemination, it is suggested that you take a look at most of the systems described. This is the preferred approach, since the answer to many information retrieval problems lies in the proper combination of methods and equipment. Also, you may find in some simple yet little known technique the necessary clue to the solution of your problem.

Identifying systems by agency. If you are interested in those systems used within a particular agency, the table of contents will direct you to the proper pages. However, please remember that this handbook includes only representative systems; therefore, no agency listing is complete and many agencies are not represented at all.

Identifying systems by method and equipment class. If you are interested in a particular information retrieval method or type of equipment, figure 1 classifies each system. While it is realized that the titles of some of the classes may not be ones with which you are familiar, or may represent classes that have also been given other titles, the system description should clarify any questions you may have.

Identifying systems by functions served. If you are interested in identifying systems by the information retrieval function served, the system titles may provide the necessary clue. However, you may find figure 2 helpful not only for this purpose, but also for gaining a better understanding of just what each system can do and what it cannot do. Please note that some of the systems in this handbook are designed to perform more than one function. The following is a definition of each of the four functional categories shown in figure 2:

DR—Document Reference (Index) Systems—Those used for conducting searches by subjects, characteristics, or attributes where the method and equipment employed merely identify, by name or number usually, the documents or other items that are pertinent to the query. If complete information is needed, the user must refer to another source, often the document or other item itself.

DS—Document Storage Systems—Those used solely for storage of documents or their images. The documents or images are arranged and also retrieved on the basis of their name, number, address location, or some other simple identifier.

URS—Unified Reference-Storage Systems—Those that combine the functions of the first two (DR and DS). These systems are able to identify documents on the basis of subjects, characteristics, or attributes, and then automatically or simultaneously present or display those documents or their images that are pertinent to the search query.

DFR—Data or Fact Retrieval Systems—Those that provide the user with the precise data or facts pertinent to his query, rather than merely referring him to a document.

Data is defined for the purposes of this handbook as discrete quantitative or qualitative information such as names of persons, places or things; dates; units of measure; and physical characteristics or attributes.

Facts are defined as complete thoughts, concepts, or answers often representing conversational like responses to the search questions and expressed often in a conversational manner, as concise sentences, phrases, or paragraphs.

Data or fact retrieval, as covered by this handbook, is of two levels:

1. *Simple data retrieval* as in situations where the requirement is merely to look up data by name, number, or some other simple means, and extract all or some of the related data found in that part of the record store.
2. *Complex data or fact retrieval* involving comprehensive searching of the system store, correlating or other manipulating of data, and in other ways developing answers to questions. (Generally, systems capable of performing

complex data or fact retrieval can also be designed to serve one or more of the first three functions above.)

How to Obtain Additional Information

Additional information regarding any specific system included in this handbook may be obtained by contacting the originator at the address shown. Inquiries may also be directed to:

Paperwork Standards and
Automation Division (NRP)

National Archives and Records Service

General Services Administration

Washington, D.C. 20408

IDENTIFICATION OF SYSTEMS BY FUNCTIONAL CATEGORY

LIST OF SYSTEMS	PAGE NUMBER	FUNCTIONAL CATEGORY			
		DR	DS	URS	DFR
Aerospace Information Dissemination	113	X	X		
Aircraft Accident Analysis	14	X			X
Aircraft Maintenance Manual, Distributing and Updating	145		X		
Allotment Disbursement Record	54				X
Animal Inventory Management	125	X			X
Automated Engineering Data Retrieval and Reproduction	32	X	X		X
Automated Merchant Vessel Report (AMVER)	131				X
Automated Name Search	122	X			X
Automated Personnel	88				X
Battelle Clue-Word Card	140	X			
Battelle Dual Dictionary Index	143	X			
Beneficiary Information	82				X
Building Space Information	34				X
Census Age Search	20				X
Computer Output Data Retrieval	137				X
Congressional Information Network	107	X			
Correspondence Retrieval	42			X	
DDC Information Storage, Dissemination and Retrieval	75	X	X		
Deficiency Identification	37				X
Engineering Drawings Storage and Reproduction (with Color Overlays)	39		X		
ERIC (Educational Resources Information Center)	80		X		
Failure Rate Data Dissemination (FARADA)	45				X
The Fosdic SS	17				X
Information Retrieval and SDI Current Awareness	98	X			
Information Storage and Retrieval for Patents (Ex)	26	X	X		

Figure 2

IDENTIFICATION OF SYSTEMS BY FUNCTIONAL CATEGORY (Cont'd)

LIST OF SYSTEMS	PAGE NUMBER	FUNCTIONAL CATEGORY			
		DR	DS	URS	DFR
JCS Records Retrieval	29	X			
Land Patent Control Document Index	93	X	X		
Legal Information Through Electronics (LITE)	57	X			X
Machine Readable Catalog Dissemination (Project MARC)	110	X			
Meat Label Storage and Retrieval	8		X		X
Medical Record Storage	78		X		
Microform Engineering Drawings Support	72		X		X
Microform Personnel Record	60		X		
Miniaturized Management Reports Distribution	63		X		
Miniaturized Navy Catalog Data	48		X		X
NASA/RECON Automated Reference	116	X	X		
National Crime Information Center (NCIC)	104				X
National Driver Register	128				X
National Employee Account Card Holders	85				X
National Marine Data Inventory (NAMDI)	119				X
National Weather Records Center	23				X
Office Files Coordinate Index	66	X			
Personnel Skills Inventory	134	X			
Pesticide Label Control	11	X			X
Public Works Drawings Retrieval	51	X	X		
RIRA-Legal Information	101	X			
SDI Current Awareness	96	X			
Technical Data Dissemination and Retrieval	69		X		X
Video Tape Information Storage & Retrieval	91		X		
ZIP Code Data Retrieval	148				X

Figure 2 (Continued)

NAME OF SYSTEM:

Meat Label Storage and Retrieval

ORIGINATOR:

Consumer Protection Program
Consumer and Marketing Service
U.S. Department of Agriculture
Washington, D.C. 20250

OBJECTIVE. To design and implement a document storage system within the Department's Meat Inspection Division that will eliminate the inefficient conventional case folder storage arrangement. Further, to insure that the new system will enhance the overall administration of the meat label approval program.

BACKGROUND. One of the responsibilities of the Meat Inspection Program is to approve the labels placed on meat or packages of meat products processed in commercial meat packing houses. All meat packing houses are required by Federal regulation to submit copies or sketches of labels for Department approval before being used on meat or meat products. Each label must meet specified Government standards with respect to the product information, such as color, quality, and kind of meat product. For example, transparent or semitransparent wrappings for such articles as sliced bacon or pork sausage should not bear colors that may give a false impression as to the leanness of the product.

Over 250,000 approved labels are on file in the Meat Inspection Division, with about 3,500 new label submissions received monthly. In order to properly administer and control the label standards program, the Division scientists and regulatory and administrative personnel need frequent information relative to approved labels. Somewhat the same information requirements hold true for the 2,000 Federal inspectors located at the various processing plants.

For some time the Division had wished to eliminate the cumbersome case folders containing bulky and odd-shaped label material. The system designers eventually selected an aperture card system (punched cards with windows for microfilm images) as being the most feasible way of eliminating unsatisfactory storage conditions, while still possessing the necessary characteristics to assure the integrity of the labels and supporting papers. Other considerations prompting the selection of this system included its ability to prepare duplicate sets for use by the headquarters and the inspectors located at meat processing plants, to accurately machine sort and arrange in numerical sequence the master card decks, and to allow for use of 35-mm. color microfilm images in lieu of black and white in instances where color could better portray label features.

The aperture card selected as the storage medium is the standard 80-column punched card with an area of about 30 columns reserved for the insertion of the 35-mm. microfilm image.

THE NEW METHOD. The initial input to the new system is the packing house label forwarded to the Meat Inspection Division in Washington, D.C., for regulatory compliance. An aperture card is punched by a Division keypunch operator for each approved label. The punched portion of the aperture card includes such data as plant number, product code, date of approval, brand number, and product description. The coded data is also interpreted and printed across the top of each card for use in manual searches at headquarters and in field packing houses. The aperture cards are then held until the approved labels and associated papers have been photographed. The filming process enables the photographing of up to four or five images per aperture card. After development and inspection, the approved microfilm is placed into the aperture card window through use of a manually operated aperture card mounting machine. When a full batch of label images have been mounted, the newly accessioned cards are manually placed in the master file. This file is arranged numerically by assigned packing house number and by brand approval number thereunder.

The master aperture card file at the head-

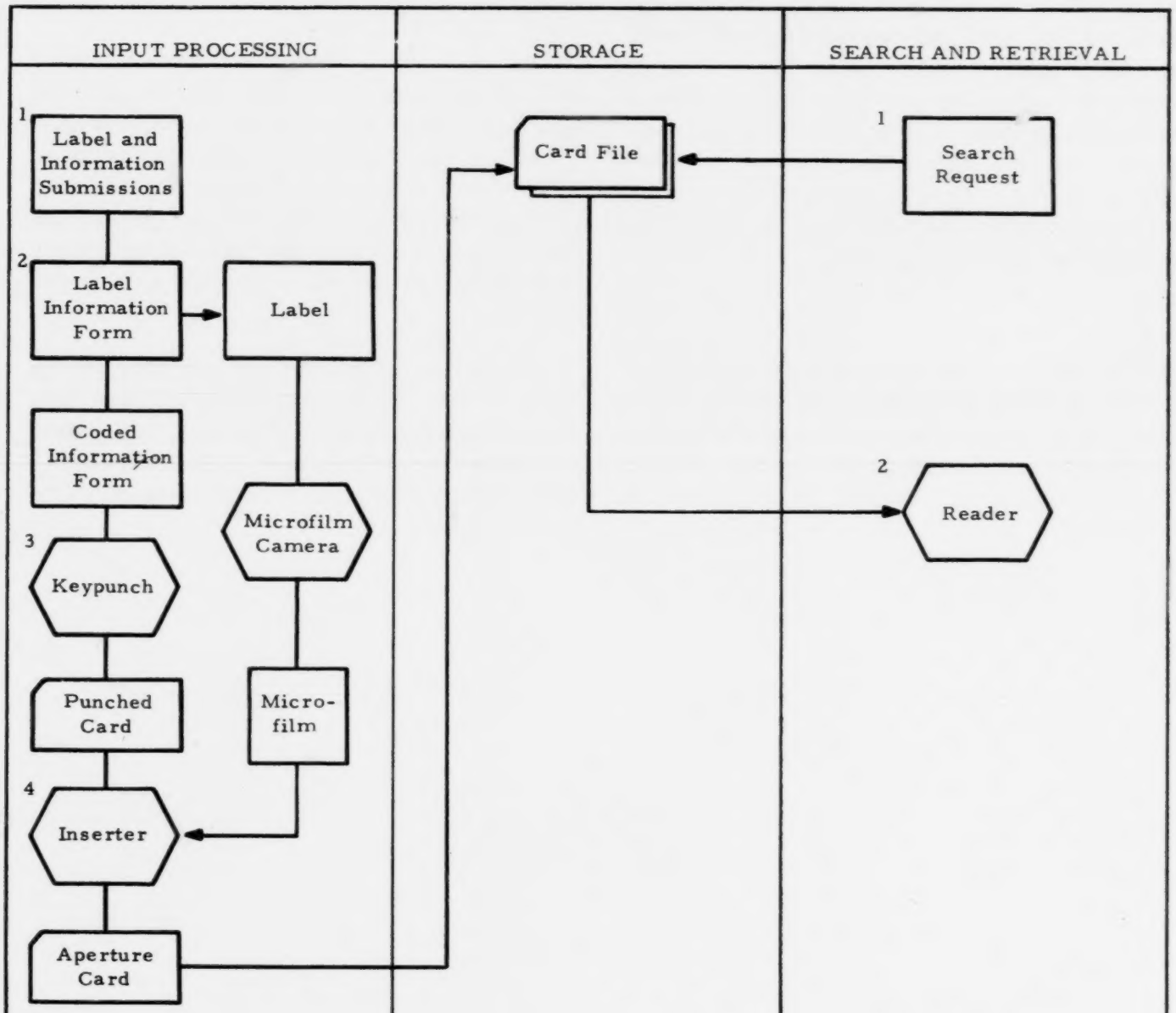
quarters represents the basic inventory of approved labels, and only manual file searches are made of these interpreted cards. Viewing the labels and related correspondence is made possible by use of standard universal-type microfilm readers. The duplicate set of interpreted punched cards that does not contain the microfilm images is arranged by product code and may be used for machine searching on punched card equipment.

REMARKS. This aperture card application combines three recordkeeping methods into one overall system. It has the document storage features of microfilm plus the mechanized sorting, arranging, and reproducing potential of standard punched cards. Additionally, it permits manual searching of interpreted cards.

In application, the system permits faster manual searches of a standard size deck of aperture cards than searches through a conventional file containing odd-size material. While file maintenance is currently the only mechanized phase of the system, the searching procedure could be mechanized with little disturbance to the daily storage and search routines.

While the most common use of aperture cards is for the dissemination, storage, and retrieval of engineering drawings, this system illustrates their usefulness in accommodating odd-sized documents or documents of eight pages or less.

MEAT LABEL STORAGE AND RETRIEVAL



1. Input information produced by the many meat packing houses.

2. Division clerk places pertinent information on information form, codes information and forwards label to camera activity.

3. Operator keypunches information onto a special aperture card. Label is microfilmed in black and white, or in color.

4. Microfilm image placed on proper aperture card through use of manually operated mounting machine.

Over 60 trays of master file aperture cards maintained by division file activity.

1. Requests originated by division personnel and identified by packing house code number.

2. File section personnel manually retrieve needed cards and place in reader for searchers use.

NAME OF SYSTEM:

Pesticide Label Control

ORIGINATOR:

Pesticides Regulation Division
Agriculture Research Service
U.S. Department of Agriculture
Washington, D.C. 20251

OBJECTIVE. To develop and operate an appropriate data or fact filing and retrieval system that will insure more efficient management and control over the Pesticide Registration Program. More specifically, to provide greater latitude, flexibility, and ready access to a variety of information needs.

BACKGROUND. The Pesticides Registration Program of the Department of Agriculture is responsible for insuring that pesticides used by farmers in producing foods will not be harmful to consumers. This program regulates the manufacture and distribution of these poisons by requiring registration of the descriptive labels placed on the containers of approved pesticides. These labels list, among other things, the chemical ingredients of the formula and the approved practices for using the formula. The regulation specifies that approved labels automatically expire after 5 years and must be renewed if their sale is to be continued.

To carry out this program scientists such as chemists, bacteriologists, and pharmacologists evaluate the toxicity and other chemical characteristics of the pesticides. A regulatory group of personnel are concerned with the proper label registration and enforcement of the pesticide law.

Because of the sensitive and exacting nature of this program, both scientists and regulatory staff members must have ready access to a variety of pesticide control information.

THE NEW METHOD. The program developers adopted a combination mechanized and manual information storage and retrieval system. A punched card system was established for the rather critical pesticide label data requirements. The information requirements under the mechanized portion include inventory status of approved pesticide labels, expiration dates, and specific information on various groups of related pesticides. The conventional manual portion of the system would handle current data on pesticide manufacturers and other general inquiries regarding the label program.

The gathering of input data for the pesticide label data file begins with the registration jacket, which contains the registration for label approval and the label to be used on the product. This document is routed to several scientific offices where the pesticide formula is examined in terms of regulatory compliance. Responsible offices affix the applicable coded pesticide information on the jacket. Upon reaching the Registration Section, the information is transferred to a Pesticide Registration Form by a coding clerk.

The Data Processing Unit accepts the coded information from the Registration Section, and the keypunch machine operator punches the coded information into punched cards. Descriptive data codes are needed to permit the key information to be contained within the 80-column limit of the cards. The keypunch equipment has the additional capability of printing the coded data across the top of the punched card. The completed cards are filed mechanically by punched card sorting equipment, in pesticide label registration number sequence. Expired cards are withdrawn during the same sorting runs. The master file totals about 60,000 punched cards.

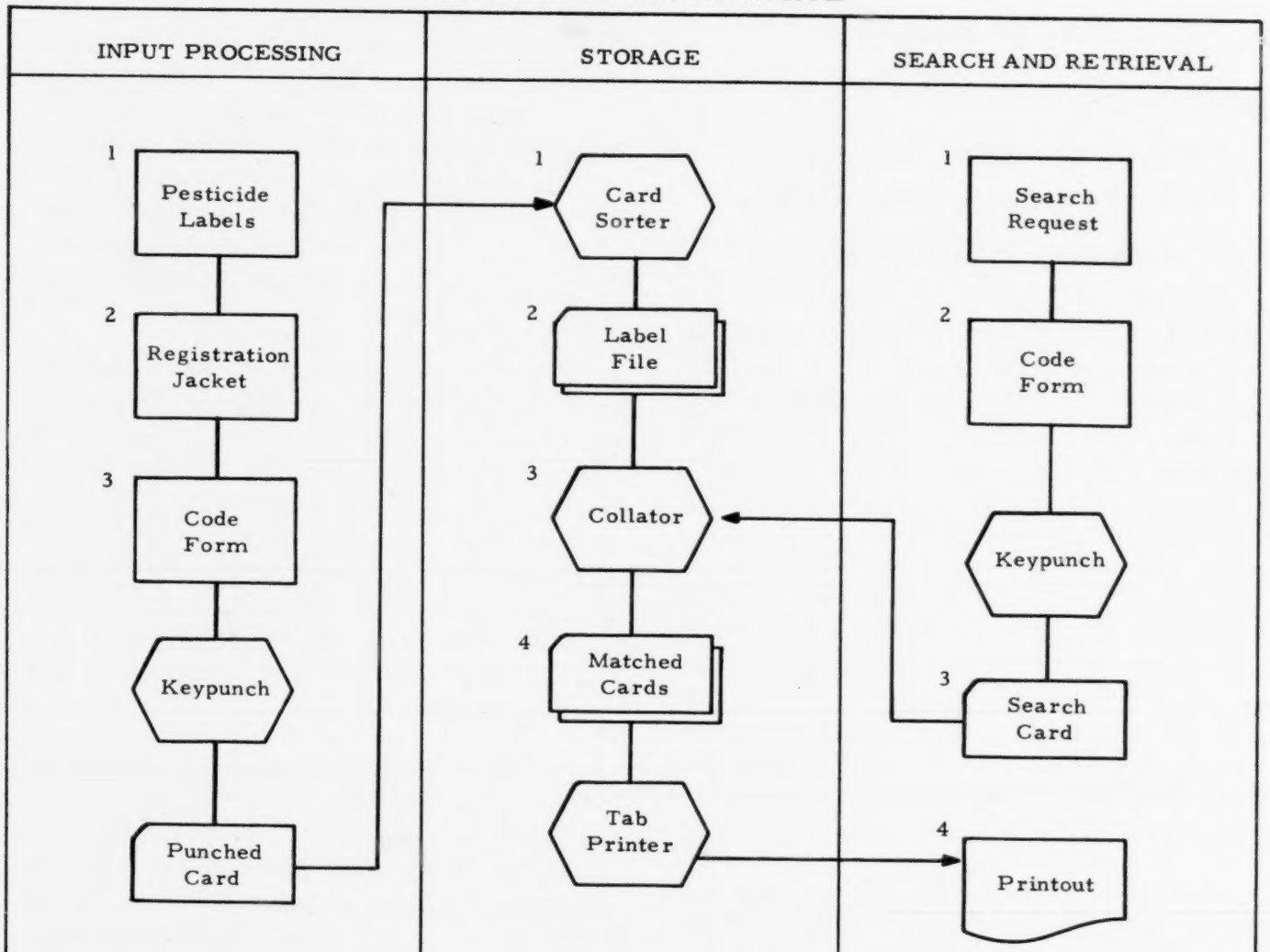
This system also has the capability of coordinate type searching of the pesticide label file. In this type of search, the entire file is processed through the collating machine, which compares each card with a coded search card. Cards that match the wanted terms drop into a pickup hopper and are then placed in the list printer, which prints out the coded information at a speed of 100 lines per minute. The precise list of label information is then forwarded to the office needing the information.

REMARKS.[1] The mechanized features of the Pesticide Label Control System permit relatively easy updating and purging of the master label file. Such characteristics also assure accurate mechanized coordinate search capability, which is important in the monitoring of pesticide chemical properties. The system also possesses the flexibility for optional manual selection and filing of cards. Additionally, the punched card used in the system provides for a simple, fast, economical conversion to computer use should the system's growth warrant the change.

The two standard restrictive factors in any punched card system are the limited space for data and the relatively slow processing output speed as the card file grows in size.

[1] During the time period involved in issuing this handbook, the Pesticides Regulation Division has been transferred to the Environmental Protection Agency.

PESTICIDE LABEL CONTROL



1. Information produced by label manufacturers and distributors

2. Scientists and others enter coded information.

3. Data processing unit converts coded information into coded punched card.

1. New cards merged with master file by label registration number.

2. Master file contains full inventory of label information.

3. Collator identifies matched cards and places in hopper.

4. Matched cards placed in tab printer for printout of information.

1. Official desires information on all labels containing certain chemical properties.

2. Data processing unit converts coded information into coded punched card for machine search of matching information.

3. Search card placed in collator. Total master file will be passed by search card for matching.

4. Machine produces printout of all labels with properties desired per search request.

NAME OF SYSTEM:

Aircraft Accident Analysis

ORIGINATOR:

Bureau of Safety
Civil Aeronautics Board (CAB)
Washington, D.C. 20428

OBJECTIVE. To establish a data or fact information retrieval system that will enable the Bureau of Safety to promptly answer questions and conduct analyses on aircraft accidents. Further, to use this wealth of stored information in studies aimed at reducing civil aircraft accidents.

BACKGROUND. The Bureau of Flight Safety is responsible for promoting safety in civil aviation. The Civil Aeronautics Board (CAB) investigates accidents involving civil aircraft and holds public hearings to help determine the cause of accidents. It also conducts special studies and investigations to reduce the rate of aircraft accidents.

The growing size of the civil aviation fleet has made it necessary for the CAB to design an information system with a much wider range of storage and retrieval capabilities than former methods. More specifically, the new system had to be able to compile, store, manipulate, and update large amounts of data concerning the more than 5,000 civilian aircraft accidents occurring annually. The system also had to possess the capability for periodically producing reports and statistics on these accidents. Additionally, on individual accidents, it had to render complex accident analyses and provide precise data on demand.

The CAB study group found that the only functional category of methods and equipment that could meet these needs was a complete data or fact retrieval system. The class of equipment selected was an electronic computer using magnetic tape.

THE NEW METHOD. The source information—about 100 aircraft accident reports weekly—is received at CAB headquarters from the field investigators of the Federal Aviation Agency and the Civil Aeronautics Board. These typed unpublished accident reports range from 10 to 50 pages, depending upon the nature of the accident. Individual reports may be indexed under as many as 50 terms, such as registration of aircraft, owner of aircraft, date of accident, plus a series of terms to describe specific accident characteristics.

The Analysis Division, Bureau of Safety, converts the report information into codes representing the accident characteristics. A dictionary of approximately 3,400 terms is used jointly with the term code book as indexing tools. The codes selected to describe accident report information are keypunched into punched cards that are subsequently batched, converted to magnetic tape, and merged with the master tape record of aircraft accidents.

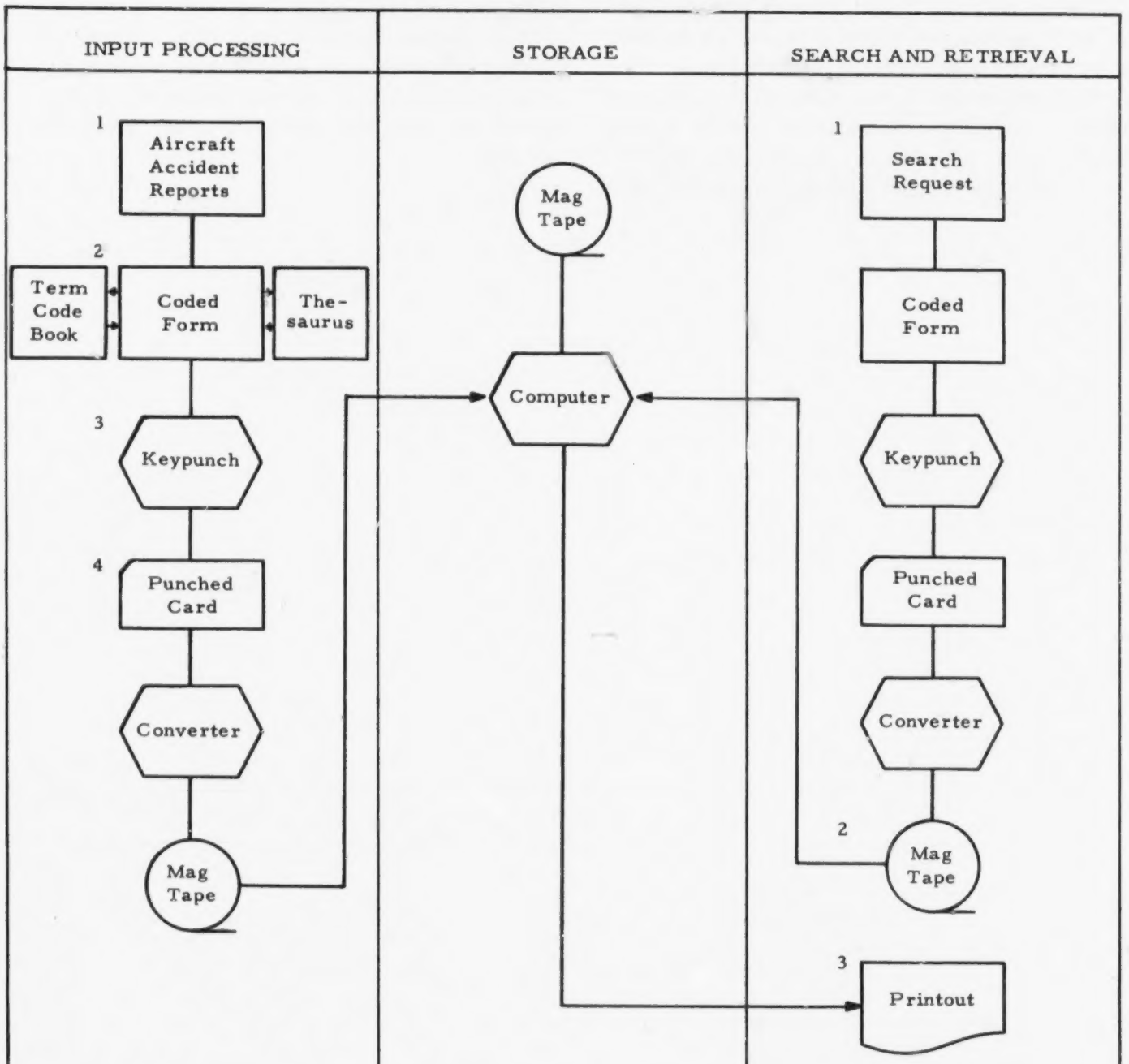
Search actions are usually prompted by inquiries received by mail or interoffice memorandum. Special reports are normally generated by the Board, the Federal Aviation Agency, the National Aeronautics and Space Administration, and other organizations associated with the problem of aviation safety. To conduct a search, each request for accident information is converted to magnetic tape in the same sequence and manner as the original accident data entered onto the master tape record file.

In the actual data retrieval process, the magnetic tape containing the search questions is "read" into the computer for matching against the master tape record according to the program instructions, with the retrieval of the requested information presented in printout form.

REMARKS. The initial input conversion costs of this system are relatively high when compared to noncomputer retrieval methods, due to the complex details associated with planning, programing, and refinement activities. However, once the system is in full operation both processing and storage costs recede to a marked degree.

One of the system's greatest benefits is its ability to retain a broad base of subject matter and its program flexibility, which enables it to handle a variety of search needs. The system can answer up to 100 search questions on one programed tape run. A typical report might cover a listing of all air taxi service accidents occurring in 1969 by type of aircraft, kind of flying weather, phase of flying when accident occurred, plus many other pertinent details. These features thus free Bureau of Safety personnel to handle and evaluate a broader spectrum of current information than would be possible under manual retrieval systems.

AIRCRAFT ACCIDENT ANALYSIS



1. Reports from Field Offices flow to Washington, D.C. at an average of 100 per week.

2. Analysis division clerk converts codes reflecting accident characteristics.

3. Keypunch operator transforms coded information to machine readable language.

4. Punched card information converted to magnetic tape.

All accident report information stored on magnetic tape unit of computer system. Updating of information performed periodically.

1. Requests initiated by Bureau of Safety and other interested air safety organizations (parallel processing routine as described by items 2 thru 4 in col. 1)

2. Search questions on magnetic tape read into computer.

3. Appropriate computer program produces answers in printout format.

NAME OF SYSTEM:

The FOSDIC SS

ORIGINATOR:

Bureau of the Census

Suitland, Maryland 20233

OBJECTIVE. To develop the techniques and to operate an advanced information handling and processing system that will result in greater efficiency and economy in the processing of the 1970 census.

BACKGROUND. The Census Bureau "provides basic statistics about the people and the economy of the Nation in order to assist the Congress, the executive branch, and the public generally." The best known task performed by the Census Bureau is the "census of the population and housing taken every ten years."

The art of census taking has changed greatly since the original hand tallies that began in 1790 and continued through the 1880 count. However, by 1890 the challenges of improving the manner of recording the results of the decennial census were becoming apparent. In that year the Bureau experimented with the punched card and had a degree of success. In 1951 it installed UNIVAC I, which greatly assisted in reducing the large backlog of punched cards resulting from the 1950 tally. In that census it took over 3,000 keypunch operators to process the millions of cards of census information.

For the 1960 census the Bureau designed a new system in conjunction with the National Bureau of Standards. The key to that system was called FOSDIC, which stood for Film-Optical Scanning Device for Input to Computers. This original FOSDIC application reduced the input information handling time from 200,000 man hours for the 1950 census to 28,000 man hours for the 1960 census. In total, the FOSDIC capabilities are estimated to have saved $6 million in input costs over the 1950 system performance.

Still not fully satisfied with the 1960 results, this year's information handling procedures will again depend on new innovations and technological advancements, largely developed by the Census Bureau's Engineering Development Laboratory.

THE NEW METHOD. The 1970 population census input consists of two types of forms—a so-called 100 percent short version uncoded form to be filled out by all households, and a pamphlet-type sampling form to be completed additionally by about 1/5th of all the households. In total about 65 million of the shorter version forms will be processed and about 14 million of the pamphlet type.

The actual fully automated processing of the completed form questionnaires will be accomplished through the integration of two specially designed systems. The first, Camera 3, developed by the Engineering Development Laboratory, will include 40 separate microfilm units. The other system encompasses the FOSDIS SS model, redesigned for the 1970 census in the Engineering Research Branch. It basically consists of a computer scan unit, a console, and two servos. Six such FOSDIC units will be used to meet the tight processing schedule. The final equipment in the series of automated actions are UNIVAC computers, three of which will be used—two model 1108's and one model 1107.

The processing program calls for the uncoded type form to be fully processed prior to the pamphlet-type household form, which needs some manual coding prior to being machine processed. The 100 percent use form will require about 130 million microfilm frames (images) for the total program, which means a daily production of about 1.1 million frames.

The input sequence of the 100 percent form starts with the Camera 3 processes. First the forms are placed face up on the special vacuum feed belt that brings the document into position for microfilming. A photocell technique insures proper positioning for the camera exposure of about 100 frames per

minute. The film is then developed in negative film form, as this method allows the questionnaire form's marks and filled-in circles to show as clear spots on the film.

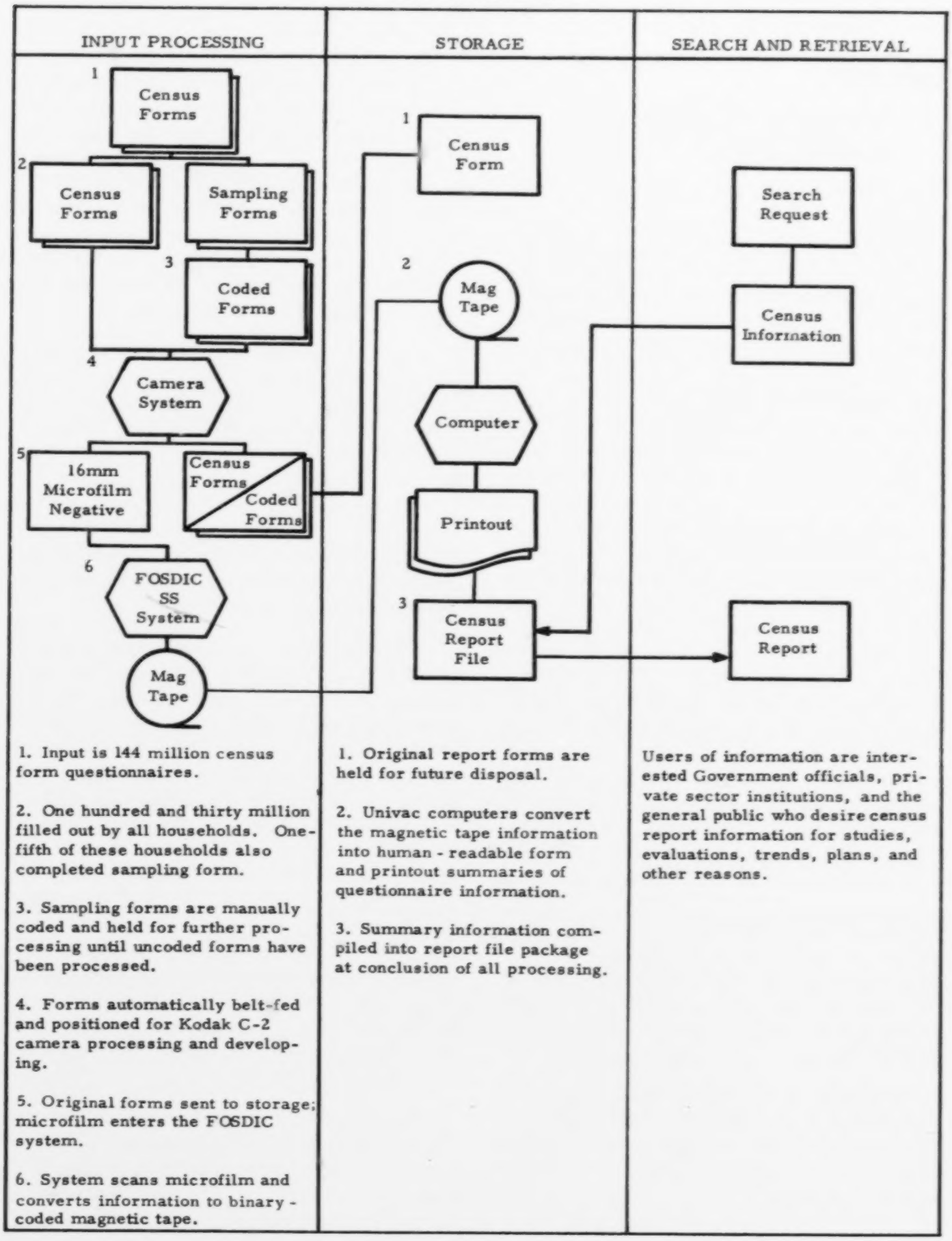
The developed film then moves to the FOSDIC operation where it is converted to magnetic tape. The film is first carried through an aperture where a "flying spot scanner" records the relative film shadings of dark, gray, and clear, including the marked answers on the questionnaire. These resultant electrical impulses are transferred to the FOSDIC computer section where they are converted to binary-coded, input magnetic tape. In the final step the computers convert the compatible magnetic tape information into human-readable form. The output product is a statistical summary printout of the questionnaire answers.

The magnetic tape records are then indexed and filed in an appropriate arrangement. The printout information is converted into statistical summaries for use by the Census Bureau and other Government agencies. After proper analysis and interpretation, the results will be disseminated to the nation through a variety of Government publications and other communication media.

REMARKS. This FOSDIC SS, CIM (computer input microfilm) System is a prime example of the technological breakthroughs in automated, information processing capabilities that have occurred since the taking of the last census. In 1960, for example, the system transferred the equivalent of 8 hours of punched card data into magnetic tape in 1 minute. The 1970 system performs this same function in 12 seconds. In addition to the reduced processing time, the automatic features of document handling and information extraction insure error-free printouts of census results.

The sophistication, costs, and processing capabilities of this unique system may now be beyond the requirements of most information handling activities. However, as beneficial innovations reach the market place these CIM characteristics and automated document handling features will become more feasible for use on less demanding applications.

THE FOSDIC SS


INPUT PROCESSING
STORAGE
SEARCH AND RETRIEVAL
1
Census Forms
2
Census Forms
Sampling Forms
3
Coded Forms
4
Camera System
5
16mm Microfilm Negative
Census Forms
Coded Forms
6
FOSDIC SS System
Mag Tape
1
Census Form
2
Mag Tape
Computer
Printout
3
Census Report File
Search Request
Census Information
Census Report
1. Input is 144 million census form questionnaires.
2. One hundred and thirty million filled out by all households. One-fifth of these households also completed sampling form.
3. Sampling forms are manually coded and held for further processing until uncoded forms have been processed.
4. Forms automatically belt-fed and positioned for Kodak C-2 camera processing and developing.
5. Original forms sent to storage; microfilm enters the FOSDIC system.
6. System scans microfilm and converts information to binary-coded magnetic tape.
1. Original report forms are held for future disposal.
2. Univac computers convert the magnetic tape information into human-readable form and printout summaries of questionnaire information.
3. Summary information compiled into report file package at conclusion of all processing.
Users of information are interested Government officials, private sector institutions, and the general public who desire census report information for studies, evaluations, trends, plans, and other reasons.

NAME OF SYSTEM:

Census Age Search

ORIGINATOR:

Public Information Center

Bureau of Census

Pittsburg, Kansas 66762

OBJECTIVE. To accelerate the conversion of the geographically-oriented census records to an alphabetic name file to improve search efficiency in order to process increased volumes of inquiries received from the public.

BACKGROUND. The Public Information Center provides the public with legal proof of age, citizenship status, and family relationships through searches of microfilm files. The Center has a major problem in searching the microfilm records of these original census of population documents, since the listings are geographically oriented, while the searches are name oriented. A search under such conditions has always been time consuming, frustrating, and occasionally fruitless. To correct this situation, the Census Bureau, over a period of years and within its limited budget outlay, has been cross-referencing the geographically oriented State files to a surname-coded reference system. Because of the enormity of each State's file of census participants, the soundex code system of surname identification was adopted. This system uses a combination of four alpha-numeric characters to represent the last name; that is, the first letter of the surname followed by three numerical codes representing the three or less consonant sounds contained in the remaining letters of the name. With literally millions of names to be processed, progress in converting the file was relatively slow.

With the passage of the Medicare Act by the Congress in 1965, the resultant deluge from the public for confirmation of age caused a greatly accelerated emphasis on conversion of the State files.

THE NEW METHOD. The conversion of the 1910 census records to soundex-coded surnames is being done on a State-by-State basis. The input for this accelerated conversion effort initially covers the keypunching of the name, age, references, and other identifying data on punched cards. These punched cards are then converted to magnetic tape, and through use of a special computer program each surname is assigned the proper soundex code. An additional computer program provides for a complete sequential sort by soundex code of all names within a given State. The sequence following the surname includes the first name, middle initial, and lastly the county of residence.

When all listings have been sequentially placed on the magnetic tape, the file is ready for conversion to microfilm. This action is made possible through use of COM (computer output microfilm) equipment that is capable of automatically entering photo-optical binary codes on microfilm. Each 16-mm. microfilm frame consists of the entries for five families, with identifying photo-optical binary-coded data covering only the fifth or last family shown in the frame.

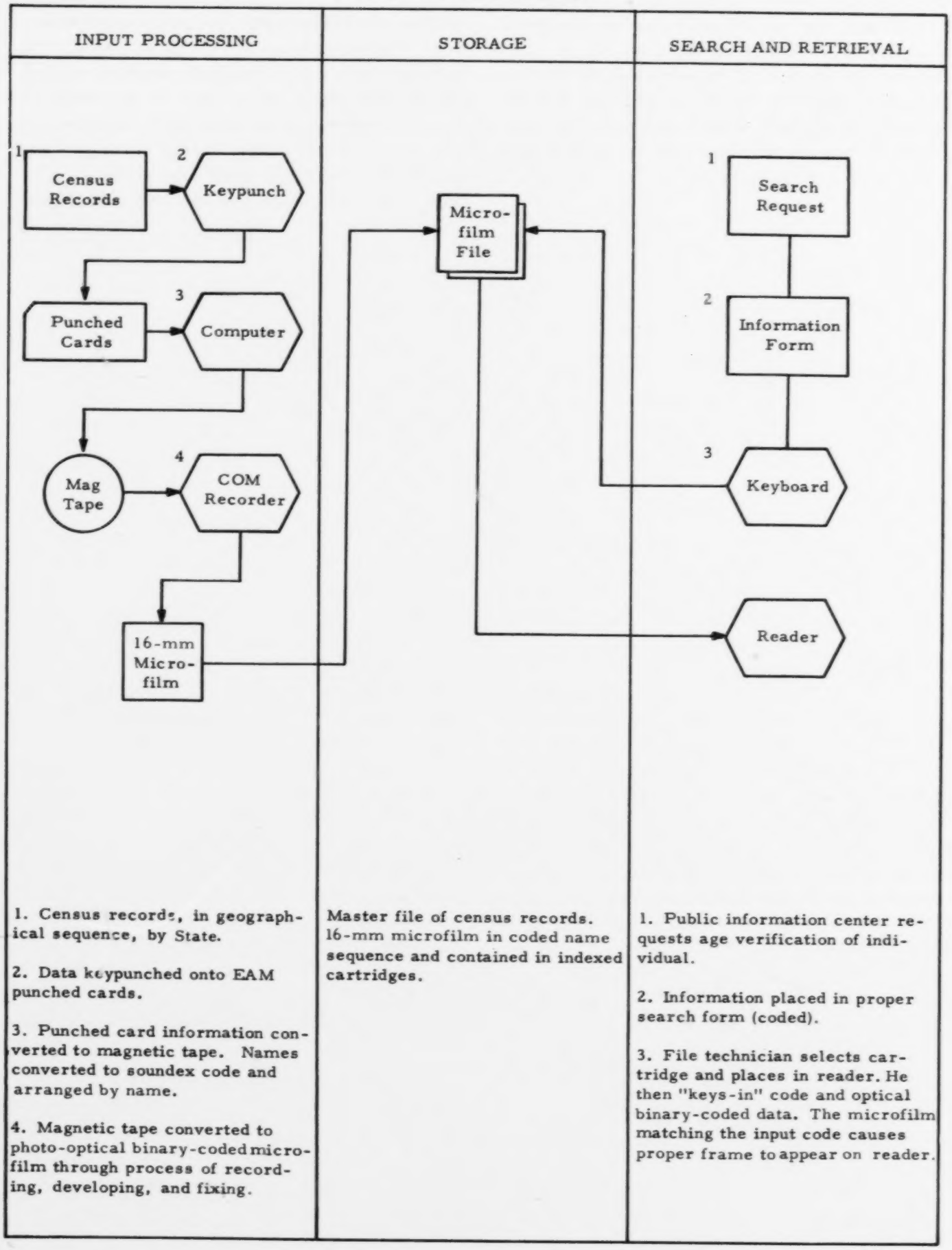
A typical State's soundex-arranged population file contains about 150 100-foot cartridges. Within the cartridge the data on each listing is arranged first by the first letter and three digits of the soundex code, then by the first four letters of the given name, and finally by the county of residence. A typical search station consists of three interrelated components. In sequence of use they are the film cartridge rack, which can hold over 200 film cartridges within easy reach of the search station operator; the electrically-operated microfilm reader, a standard Lodestar Recordak model with a capability of moving film at the rate of 10 feet a second; and the key device for this photo-optical, binary-coded microfilm system, the automated retrieval keyboard.

To conduct a search, the operator selects the appropriate microfilm cartridge, places it in the reader, and "keys in" the appropriate soundex code representing the name being looked up, followed by the given name and county code. With all information placed in the microfilm reader, the operator turns on

the start button. When all the keyed-in data matches the binary coding on a particular film frame, the reader will display the next image, which should be the film frame containing the requested information. If the individual's residence location was not known initially, a slightly wider search of the film might be necessary, especially if the surname were fairly common.

REMARKS. This roll microfilm system with optical binary code and computer-like image-finding capability lends itself to precise selection of desired documents. For example, this updated system has enabled searchers to find the desired name 50 percent of the time in the first viewing of the microfilm. In contrast, the older manual reader search through geographically arranged files was successful in only 15 percent of the first searching attempts.

CENSUS AGE SEARCH


INPUT PROCESSING
STORAGE
SEARCH AND RETRIEVAL
1
Census Records
2
Keypunch
Punched Cards
3
Computer
Mag Tape
4
COM Recorder
16-mm Micro-film
Micro-film File
1
Search Request
2
Information Form
3
Keyboard
Reader
1. Census records, in geographical sequence, by State.
2. Data keypunched onto EAM punched cards.
3. Punched card information converted to magnetic tape. Names converted to soundex code and arranged by name.
4. Magnetic tape converted to photo-optical binary-coded microfilm through process of recording, developing, and fixing.
Master file of census records. 16-mm microfilm in coded name sequence and contained in indexed cartridges.
1. Public information center requests age verification of individual.
2. Information placed in proper search form (coded).
3. File technician selects cartridge and places in reader. He then "keys-in" code and optical binary-coded data. The microfilm matching the input code causes proper frame to appear on reader.

NAME OF SYSTEM:

National Weather Records Center (FOSDIC IV)

ORIGINATOR:

Weather Bureau

Environmental Science Services Administration

Department of Commerce

6010 Executive Blvd.,

Rockville, Maryland 20852

OBJECTIVE. To establish a practical system for gathering, processing, and storing large masses of Weather Bureau observation data. Further, to store this data in a format suitable for high-speed machine searching in connection with weather research programs.

BACKGROUND. The Regional Weather Records Processing Centers are responsible for routine processing of domestic United States Weather Bureau surface observations. The National Weather Records Center routinely processes upper-air data, marine data, and data gathered outside the country. Punched cards and computer processes are used in all stages of the various weather observation tasks. Upon completion of routine processing, the punched cards and other source records become part of the permanent record collection maintained at the National Weather Records Center, Asheville, N.C.

The succesful employment of data processing equipment for the preparation of climatological statistics began in 1936 when punched cards were used for summarizing more than five million marine observations. Since then the use of punched cards has accelerated constantly, and by 1961 the Asheville facility contained over 400 million cards.

With the knowledge that punched cards are not the best medium for permanent storage of this historical data, the Weather Bureau turned to the microfilming of these records. To more effectively perform this task, a special camera was designed which microfilms punched cards at the rate of 840 cards a minute. This capability allows for a placement of 12,000 card images on each 100 foot roll of 16-mm. microfilm and reduces the data space needs by a ratio of 180 to 1. The original microfilm is retained in the master file and a positive film is produced for the working copy on which the punched holes appear as transparent square spots.

In the late 1950's, to make the microfilm punch card images practical as a machine processing medium, a high-speed electronic optical film reader called FOSDIC II (Film Optical Sensing Device for Input to Computer) was designed and built by the National Bureau of Standards and placed into operation at the National Weather Records Center. This equipment had the capability of searching any 10 columns of card images, based on plugboard programing, at a rate 5 times faster than that of punched card input.

THE NEW METHOD. A new Model IV FOSDIC developed by the National Bureau of Standards was recently integrated into the Weather Bureau's Asheville, N.C., data processing activity. This model FOSDIC IV is especially designed for rapid scanning and selection of data and can read the punched card data contained on microfilm 4 times as fast as the FOSDIC model II. This processing rate corresponds to a column-by-column examination of 2,000 full cards per minute.

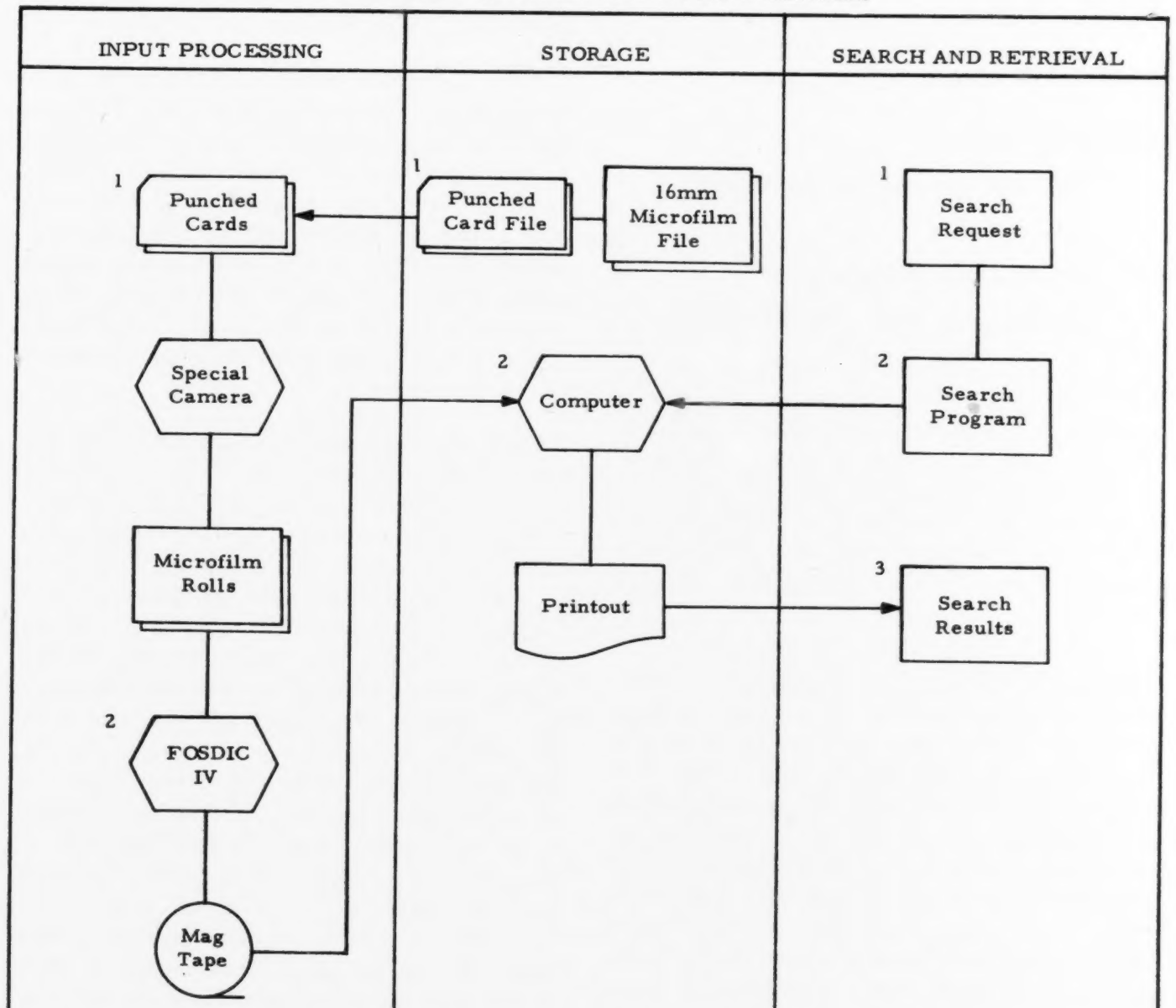
Using a plugboard program, an electronic optical scanning device reads the spots on the microfilm created by the holes in the punched cards and converts the spots to binary-coded information on magnetic tape. The data on the magnetic tape can then be used as input to normal computer processing.

To better understand the full processing cycle of historical weather data available for study, let us assume that a group of meteorologists wish to study the winter season, West Coast entry point of storm tracks arriving from the Pacific Ocean. The group feels that the scope of research should include all records of the area accumulated since 1960. Further, let us assume that these 400,000 records, representing the weather data for the period, are still in punched card form at the Weather

Bureau's National Records Center. Initially, these cards become the input to the microfilming processing sequence and conversion to microfilm. The FOSDIC IV operation next transcribes the microfilm data into binary-coded magnetic tape. Finally, based on somewhat sophisticated computer programs, the magnetic tape is processed through the computer with a resultant printout of the requested data.

REMARKS. The Weather Bureau initially turned to microfilm as a permanent storage method because it insures file integrity and lasting record life. It is also reproducible at a relatively low cost. The punched card means of permanent storage has such limitations as bulk, a tendency to deteriorate over a period of time, and the possibility of loss or mutilation. Additionally, microfilm is far faster as input to computers.

NATIONAL WEATHER RECORDS CENTER



1. Weather bureau historical records on punched cards are converted to data on microfilm rolls through use of special microfilm camera. Product is 100 ft. rolls of 16-mm microfilm containing 12,000 card images.

2. The FOSDIC IV optical scanning processes transcribe microfilm data to magnetic tape in binary code.

1. National Weather Records Center, Asheville, North Carolina houses historical weather records on punched cards. Conversion to microfilm continues.

2. Magnetic tape file of appropriate weather data serves as input to computer. Tape information is matched against search program. Results are retrieved in printout form.

1. Scientists or other study groups determine subject and scope of inquiry.

2. Data processing office personnel develop search program.

3. Search results given to requester.

NAME OF SYSTEM:

Information Storage and Retrieval for Patents

ORIGINATOR:

Electrical Examining Operation

Patent Office

Department of Commerce

Washington, D.C. 20230

OBJECTIVE. To design and evaluate a completely mechanized document storage and retrieval system that would accelerate the retrieval of patent information for review by examiners. Additionally, to provide the capability for the identity and retrieval of a broader selection of relevant patent information.

BACKGROUND. The Patent Office maintains a central records file containing more than 3¼ million approved patents classified into more than 300 classes and 57,000 subclasses. Government regulations specify that the approval of any new patent application must be based on "novel or original features." Compliance with this policy thus demands a high degree of search accuracy and recall capability. For example, patent examiners must review all approved patents that seem related to or have the same features as new patent applications.

For years the Patent Office had been investigating new approaches to the problems inherent in the conventionally maintained hierarchical subject classification file of patents. As the file size increased, searching speeds and file accessibility became a critical problem. As one possible solution to the information problem, a Patent Office study group selected 6,000 patents for initial conversion to an experimental mechanized storage and retrieval system.

THE NEW METHOD. This experimental system uses three types of information retrieval equipment and processes in support of this effort. They are a 1401 IBM computer, a plastic microfilm jacket, and mechanical card-selecting equipment.

The computer serves as the storage medium for the patent reference index. It maintains the important descriptive data necessary to the identification of patents having relevance to new patent applications. The main reason for the success of the document retrieval function is the seven digit patent serial number. In patent searches, the computer selects and prints a list of pertinent patent numbers in accordance with the search index terms used.

For the document storage function, the study group selected a 4 x 6 inch plastic microfilm jacket coupled with a Randomatic mechanical card selector device. These media were chosen because of the relatively low cost of jacket preparation and the fast retrieval features of the mechanical selector device. In converting to the microfilm jacket system, the initial action involved the computer-assisted identification and selection of the 6,000 patent documents from the conventional file. A standard 16-mm. camera was then used to microfilm the selected patent documents. After film development, the roll film was cut into 12-image strips and manually inserted into the jacket pockets. The final step before filing of the jackets was the placing of the code notches on the bottom edge of each jacket through use of a special punch. The notches represent the seven digit patent serial number and are the means by which the mechanical selector device identifies individual film jackets.

The storage file environment includes an integrated keyboard, jacket selector device, and film jacket container. Because of characteristics of the coding and retrieval routine, microfilm jackets may be filed in random sequence.

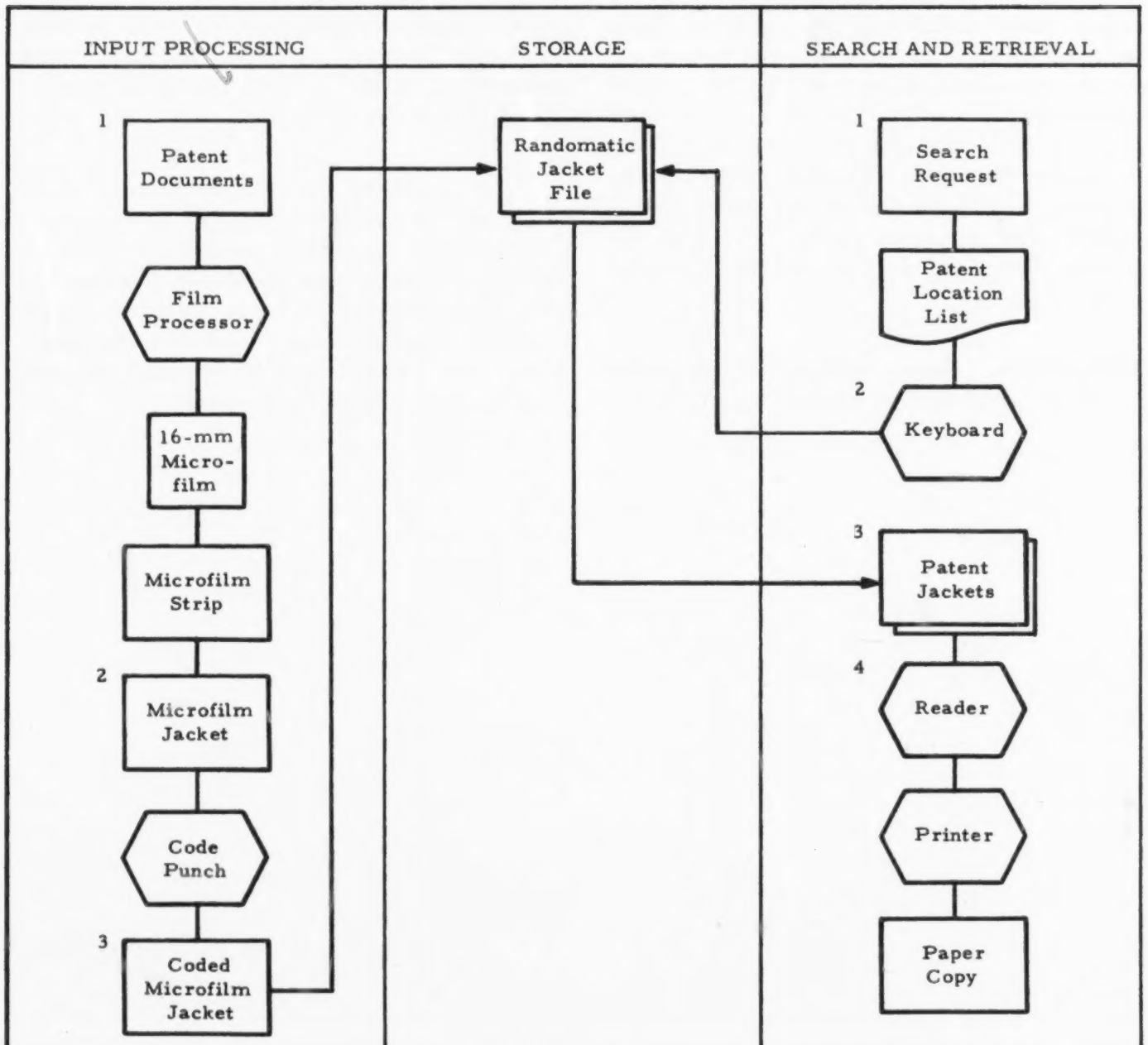
To retrieve a jacket, the file technician first refers to a computer printout listing of patents and identifying numbers coinciding with the patent examiner's request. Using the integrated keyboard, the clerk keys in the patent numbers. A mechanical actuating unit then causes the identified patent jackets

within the file to raise slightly above the others. Retrieval then consists of picking the raised jackets out of the file container. These selected jackets are given to the patent examiner for preliminary study on the nearby search reader-printer. Should the examiner desire a more detailed study of the patent, the technician can quickly make a film-to-film reproduction of the full jacket, which can be used by the examiner in his work area for reading purposes or for making selective paper copies.

REMARKS. This mechanized microfilm jacket retrieval system has the capability for fast selection and retrieval of needed documents on a continuing basis. Its features that permit random refiling of returned jackets also save considerable time. The plastic film covering of jackets affords maximum protection to the microfilm strips.

The nature of patent examination work often requires detailed study of patent documents. Thus, the patent information needs to be close to the work area. While the acquisition and maintenance costs are rather high for such a system, there is always the possibility that it might be fully justified through improved program effectiveness.

INFORMATION STORAGE AND RETRIEVAL FOR PATENTS



1. Patent documents are batched, microfilmed, developed, and cut into strips containing 12 images.

2. Clerk punches proper retrieval codes into microfilm jackets.

3. Coded jackets are forwarded to file station.

File station contains coded microfilm jackets in random filing order.

1. Patent examiner requests patent documents.

2. File technician refers to computer printout listing for location code and keyboards the code into mechanical jacket selector file.

3. Technician retrieves raised jackets from file.

4. Patent examiner studies selected jacket images in reader. Paper copies are made of appropriate images.

NAME OF SYSTEM:

JCS Records Retrieval

ORIGINATOR:

Documents Division, Joint Secretariat Office, The Joint Chiefs of Staff (JCS) Washington, D.C. 20301

OBJECTIVE. To develop and operate a nonconventional document identification and retrieval system that will provide key Joint Secretariat officials and "action officers" with desired information in a more responsive and efficient manner.

BACKGROUND. The Joint Secretariat of the JCS primarily supports the Chairman in his duties as chief military advisor to the President, the National Security Council, and the Secretary of Defense. In performing these duties the Staff prepares strategic plans and provides for the strategic direction of the Armed Forces. The documentary support of these often critical responsibilities is the Records and Information Retrieval Branch, Documents Division, which is the focal point for document management. The former conventional methods of performing document classification, storage, and retrieval activities could not cope with the increased workload resulting from unsettled world conditions.

Due to the relatively slow reaction time to document requests, officers and other researchers were spending considerable manhours in attempting to correlate and retrieve information. As a result of this steady deterioration in document response, responsible authorities recommended that a feasibility study be conducted with a view toward improving the document management activity. Numerous mechanical and automated indexing and retrieval methods and systems were evaluated in terms of the office's requirements. The study resulted in the selection of an optical coincidence coordinate indexing system as being the most practical method for improving the system.

THE NEW METHOD. The Termatrex optical coincidence system was chosen as the best for their particular needs. The key feature of this system is a 9 x 9 inch opaque plastic index card. This card contains 100 vertical code positions and 100 horizontal positions for punching holes, a total of 10,000 positions. All hole or code positions radiate up and across from the lower left-hand corner. To identify these positions, a four digit numbering method is used. The first two digits represent the vertical positions and the last two digits, the horizontal positions. For example, position number 2256 would represent a hole location 22 positions up from the card's left-hand corner and 56 positions to the right. All like hole positions represent the same number on each card.

Each optical coincidence card represents a particular term that has been authorized for inclusion in the "Joint Glossary for JCS Records." This glossary consists of keywords and terms derived from technical, scientific and military terminology, and the natural language. The glossary's primary purpose is to aid and control selection of keywords and terms and to keep the number of term cards to a practical minimum. New terms are added as they become necessary in the identification process. Currently there are about 2,500 terms listed in the glossary. Aside from the coincidence cards, the Termatrex system also consists of a hole drilling machine and a simple, backlighted card viewing device (light box).

The input processing sequence begins with the receipt of new documents in the Records and Information Retrieval Branch. Indexing specialists assign document accession numbers both to the document and to a worksheet form. Additional descriptive bibliographic data is also placed on the worksheet together with the key terms describing the content of the document. The document is then released for staff action, and the worksheet passes to the file technician, who pulls the appropriate optical coincidence term cards from the reference file. All term cards representing the processed document are then superimposed in the Termatrex drilling machine. The operator sets the drilling position

for the accession number assigned and drills a hole simultaneously through each term card. The cards are then returned to their proper places in the reference file.

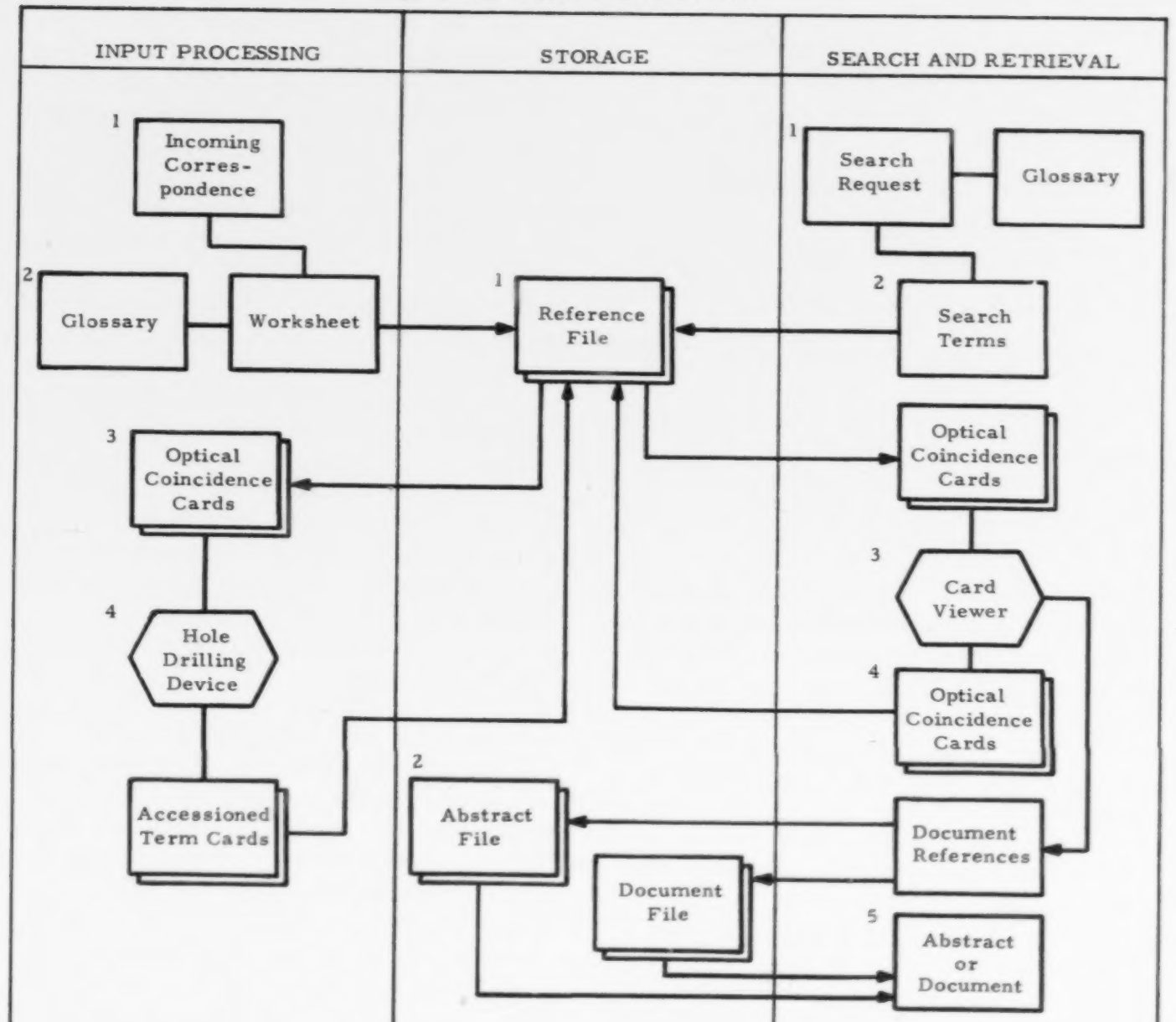
In a search situation, the user must first identify the basic terms that apply to the search request, perhaps with the aid of a file specialist and the glossary. The term cards are then withdrawn from the reference file and superimposed on top of the card viewer. Dots of light show through the coincident holes and thus indicate the documents that were indexed under the search terms. The identity of the accession numbers is then revealed by means of the viewer scale. In cases where the researcher feels that too many references are indicated, he may refine the search question by employing additional terms, which merely requires the selection of the optical coincidence cards and adding them to the stack on the viewer. Once he is satisfied with the search results he has the choice of obtaining either an abstract of the documents or the original papers. The total search routine, including document retrieval, can be accomplished in just a few minutes.

REMARKS. This system was able to meet initial study objectives at a very reasonable cost. Its relative ease of conversion to mechanized applications was also a factor in the original recommendation.

Aside from its low cost and simplicity of operation, a great advantage of this system is its excellent manipulative qualities. By adept term card selecting and shifting of cards, a user may often obtain faster search satisfaction than had the search been performed by more sophisticated methods.

While the system is excellent for identifying pertinent documents, one must always refer to a second source, either an abstract or the document itself, to determine the contents of the document.

JCS RECORDS RETRIEVAL



1. Records and Retrieval Branch specialist assigns accession numbers to both documents and worksheets.

2. Specialist lists key terms with aid of glossary.

3. With worksheet information specialist withdraws appropriate term cards from file.

4. Holes are drilled in grid positions reflecting document's accession number. When completed, cards are returned to file.

1. The Optical Coincidence Term Card File is maintained in alphabetical order and consists of about 2, 500 authorized terms.

2. Both the abstract and document file are located in close proximity to the reference file.

1. Research and action officers, with aid of specialist, settle on search terms.

2. Specialist withdraws proper cards and places them over light source.

3. Light showing through holes identifies documents with coincident terms.

4. Document accession numbers are noted and cards are returned to file.

5. The searcher requests file specialist to withdraw cited abstract or basic document.

NAME OF SYSTEM:

Automated Engineering Data Retrieval and Reproduction

ORIGINATOR:

Engineering Support Division

Procurement and Production Directorate

Army Electronics Command

Fort Monmouth, New Jersey 07703

OBJECTIVE. To establish and operate an image storage and retrieval system that will automatically locate engineering drawings and reproduce aperture cards for use in procurement actions.

BACKGROUND. The Army Electronics Command is responsible for managing the electronic-communication "commodity" for the Army. This encompasses not only the research and development activities, but also the procurement, production, and maintenance of each developed item. The Procurement and Production Directorate translates material planning and requirements (specifications) into the acquisition of specific hardware items.

Before an item can be acquired, a series of preparatory procurement actions must be taken. One of these actions is gathering the pertinent documentation making up the technical data package that is given to the prospective bidders. Accompanying each of these data packages is a set of engineering drawings and associated lists that describe in detail the item(s) to be procured. As the size of bid packages increased due to the complexities of procurement items, it became increasingly difficult to meet deadlines for distribution of the technical data package to prospective bidders. After many studies of the growing problem, the Army Electronics Command adopted a highly automated image search and retrieval system to solve the problem.

THE NEW METHOD. The Documentation Automated Retrieval Equipment (DARE) is the heart of the new system. It is used for the automatic storage and retrieval of film chip copies of coded aperture card reproductions of engineering drawings. These chips measure 35-mm. by 3 inches and contain both binary-coded identification information and the image of the engineering drawing. The film chips are stored in a special automated file container, which currently contains about 490,000 images of active engineering drawings.

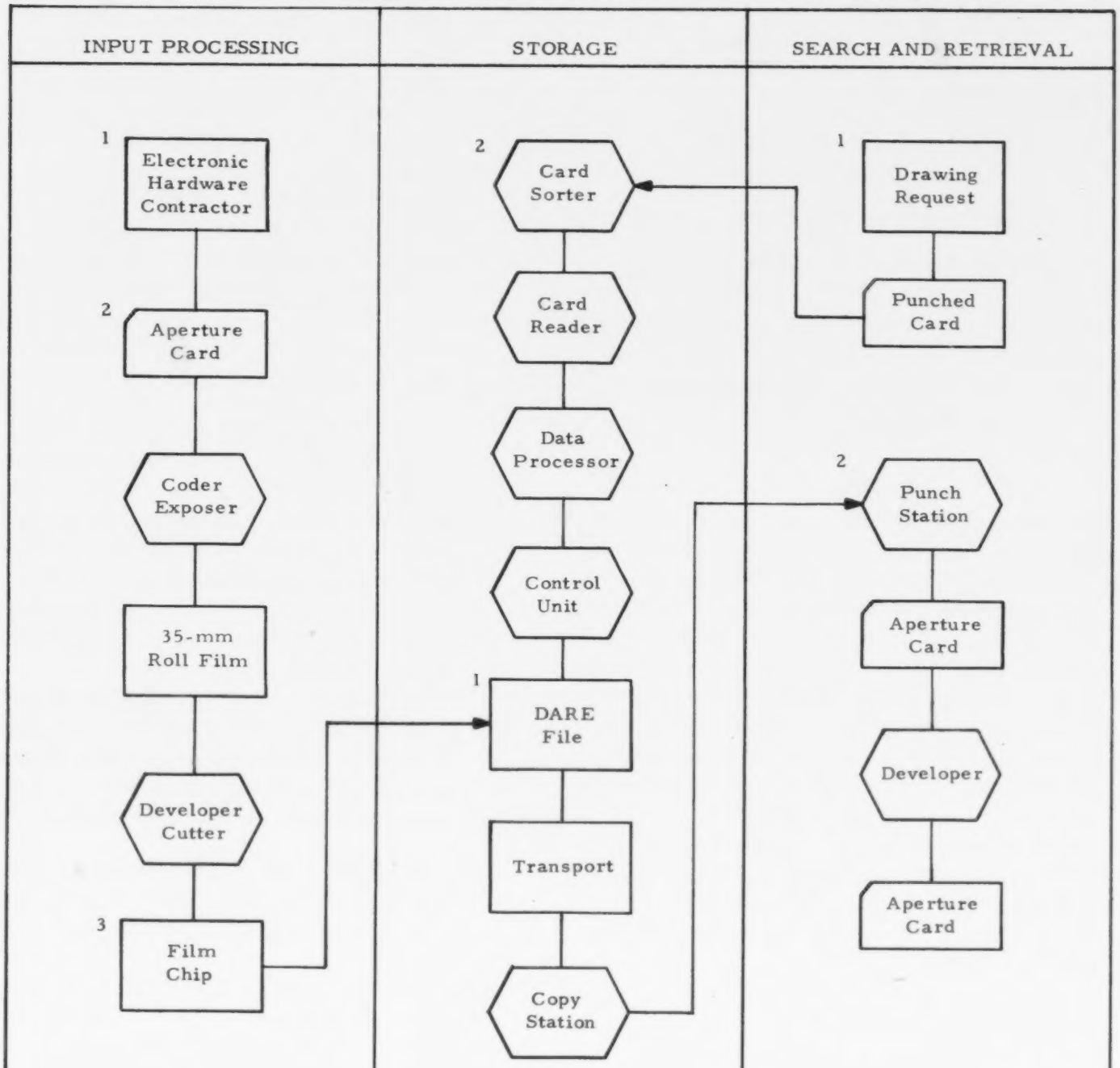
As specific groups of drawings are needed to support procurement package requirements, previously sorted punched cards containing appropriate engineering drawing data are placed in a punched card reader. The information interpreted by the reader is passed to the central processing unit that transmits the information to the control unit. The electronic impulses from this unit command the transport unit's mechanism to retrieve the proper film chip from the storage container. (The actual identification of the chip is performed by an optical reader that scans its binary-coded information for image selection purposes.) The chip image is then copied onto an output aperture card, and the binary-coded information is keypunched into the output card. Subsequent film development and interpretation (printing) at the top of the punched card are performed on-line.

The system can also be programed to automatically make multiple copies of the same drawing. Output controls allow for the proper batching of aperture cards intended for individual bid packages. As many as 4,000 engineering drawings can be selected and processed per day for forwarding to prospective bidders.

REMARKS. The DARE system is especially effective when applied to large and active files of document information that must be conveyed to users on short deadlines and in reduced size for handling and transmission purposes.

The system can store up to 855,000 engineering drawings or similar information displays, and through use of a modular concept it can double that capacity. In addition to the automatic retrieval and copying capabilities, it can also accept and purge 2,000 documents per day.

AUTOMATED ENGINEERING DATA RETRIEVAL AND REPRODUCTION



1. Inputs to system result as byproducts to hardware contracts.

2. Engineering drawing submissions are usually in aperture card format.

3. Aperture card information is converted into film chip format through series of sequential processes and is stored in DARE file.

1. DARE file with automated retrieval capabilities contains 490,000 film chips of engineering drawing information.

2. A series of on-line processes retrieves appropriate film chips from DARE file and copy identification and film image information back onto aperture cards.

1. Requests for engineering drawings to satisfy "Bid Package" needs include identity of drawings to be included in package.

2. Aperture card is developed and interpreted prior to consolidation and packaging for procurement needs.

NAME OF SYSTEM:

Building Space Information

ORIGINATOR:

U.S. Army Information and Data Systems Command

Department of the Army

Washington, D.C. 20314

OBJECTIVE. To provide management current information on the status of building space used by Army organizations in the National Capital Region.

BACKGROUND. The administrative building space reporting system was developed to better respond to property management requirements in the National Capital Region. The former manual methods of collecting and compiling building space data became impractical as new information requirements were added. Additionally, the closing of many temporary buildings under Army jurisdiction necessitated modern methods for managing the program. As a result of these factors an automated system was established in 1967 to better respond to the new requirements. Since then the system has been modified several times to comply with Office of Management and Budget and General Services Administration policies.

THE NEW METHOD. Under current policy the system requires tabular data to be reported under four specifications. These are building specifications; organization specifications; administrative space reporting master file, with update transactions and edit specifications; and administrative space master file conversion specifications.

In order to meet these requirements three magnetic tape files are maintained, which collectively are affected by 16 different computer programs. Eleven card sorts are also required to establish, maintain and produce the needed outputs. The three master files are as follows:

1. The *Space Management Master File* wherein each record contains 16 data elements that identify applicable buildings, organization, transaction data, record creation data, date of space assignment, plus individual totals of office, storage, and special-type space. In addition, each record includes the total bulding space managed during the previous quarter; personnel occupancy space on other than a prime shift; plus several other data elements. Each of the above element breakouts are maintained for each building and each organization occupying any portion of the building.

2. The *Building and Organization Table Master File* includes data elements that identify the type of file (building or organization), transaction date and code, and the Department of Defense (DOD) building code or organization code, as applicable. The building records contain location code ownership, condition code, State code, and building name and location. The organization records comprise Office of the Secretary of Defense (OSD) component code, total code, activity code, and organization name and address.

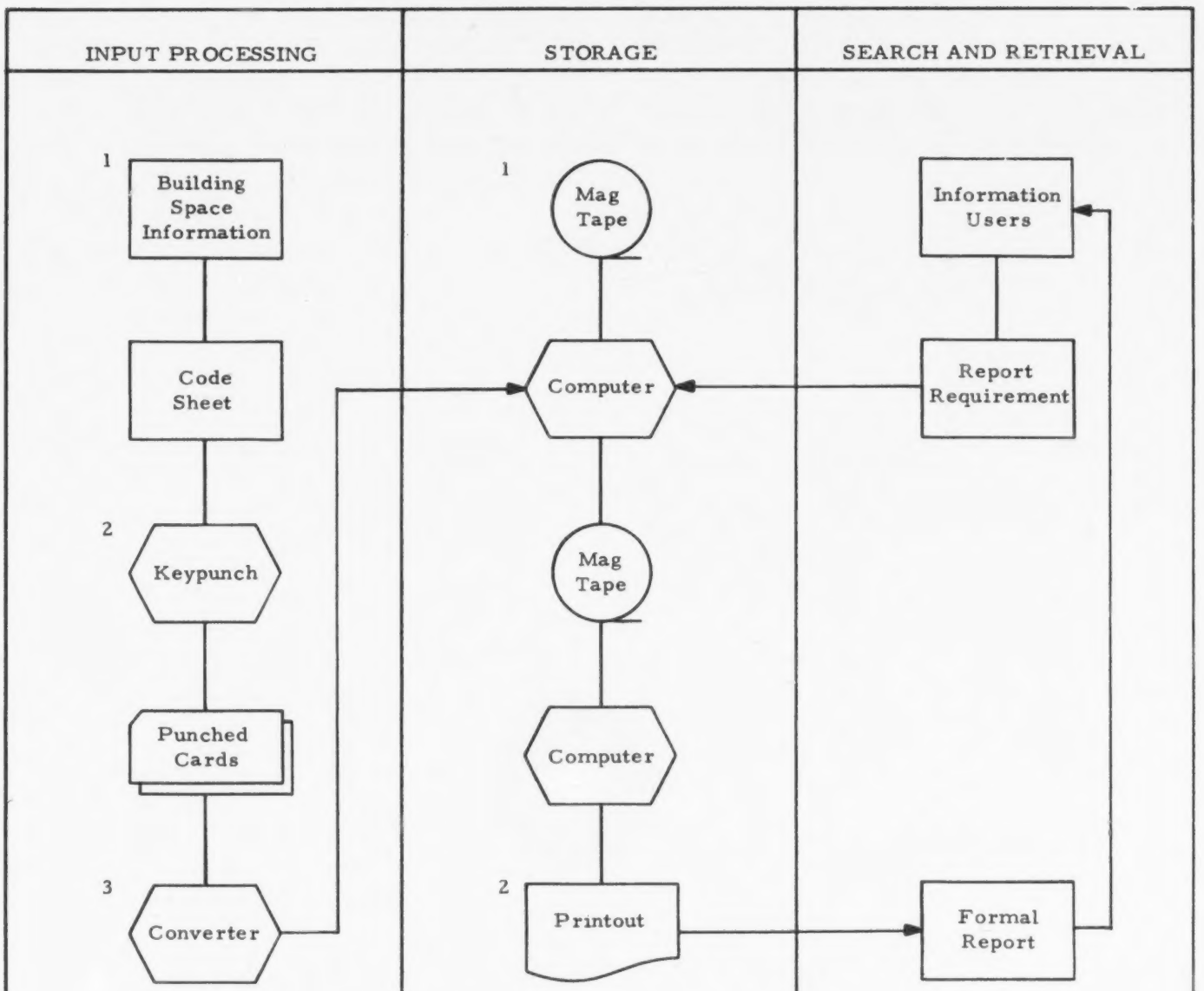
3. The *OSD Valid Transactions File* contains transaction data relative to building or organization changes.

System files are updated quarterly from administrative space reports. The processing is accomplished in initial, intermediate, and final cycles. This is to insure that all data and information contained in the initial reports are correct or are corrected as shown by intermediate cycle reports (reruns of initial cycle), and that final cycle reports accurately reflect building space status.

REMARKS. This system consists of several basic information categories with numerous reporting elements therein. Many status changes occur between reporting periods that require posting to the file record. While this information could be rendered manually, it would take considerable manpower and "lead-time" to meet reporting schedules. However,

conversion of source data to machine-readable language, coupled with sequential updating programs, make the meeting of these requirements a routine task for the computer. Additionally, the fast processing speed can give more currency to the data contained in the report. The system not only automatically produces information in a format that permits the users to conduct their own searches, but in addition has the potential for conducting an endless variety of data manipulation and retrieval actions on demand.

BUILDING SPACE INFORMATION



1. Periodic building space reports are converted to coded data.

2. Keypunch operator produces punched cards containing updated information on building space status.

3. After verification punched cards are converted to magnetic tape format and tape is placed in file library.

1. The building space management report master file is updated by merging with change tape file to produce new current master magnetic tape file.

2. Quarterly print program produces new current report on building space status.

Quarterly report delivered to users who do their own searching.

NAME OF SYSTEM:

Deficiency Identification

ORIGINATOR:

Army Information and Data Systems Command

Department of the Army

Washington, D.C. 20314

OBJECTIVE. To establish an automated data and information dissemination, storage and retrieval system which will allow Army operating agencies to better evaluate and manage inspection and audit reports of deficiencies in the manpower and monetary functional areas.

BACKGROUND. For many years, inspection and audit reports listing deficiencies in procedural compliance were reviewed and corrected at the lowest management level having jurisdiction over the matter. It became evident that the same types of deficiencies might also be occurring at those management levels where the review was being made. Consequently, it was concluded that if there was awareness of such a trend at a higher level of review, the repetition of the deficiency might be avoided through early corrective action.

In order to solve this growing need for an earlier awareness of any unsatisfactory trends at higher reviewing levels, the Army established a Deficiency Identification System within the Army Information and Data Systems Command.

THE NEW METHOD. The Deficiency Identification System's data is compiled at the management level where the inspection and audit occurs. Short extract reports concerning deficiencies are made out in accordance with standard procedures. They are then forwarded to the Army Information and Data Systems Command in Washington, D.C., for coding and classifying prior to entry into the computer's data bank.

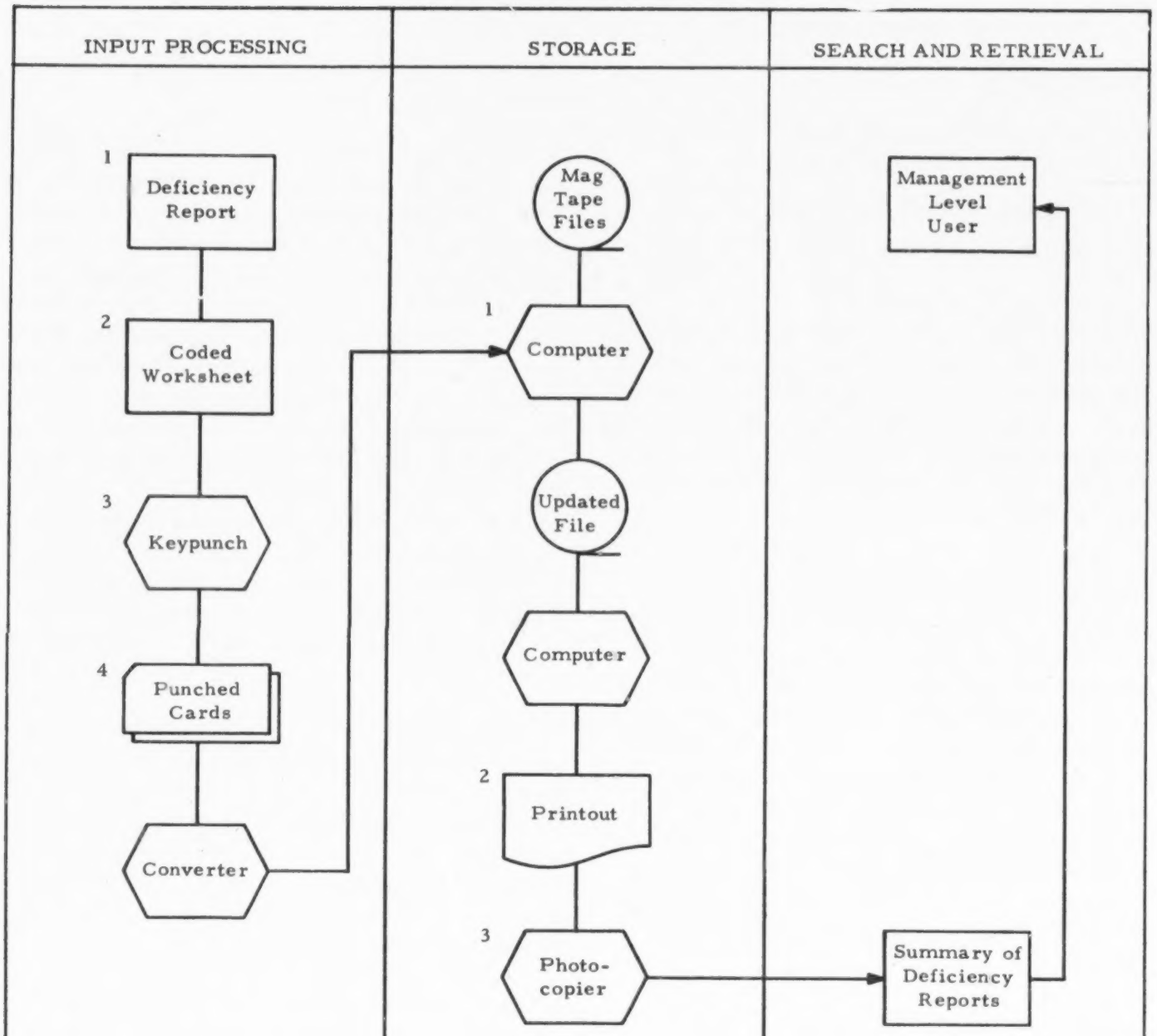
The system consists of a Master Table File and a Master Deficiency Identification File. The former file provides functional classification codes and a 65-character deficiency description for each of 165 functional or subfunctional classifications. The Master Deficiency Identification File contains specific information pertaining to 36,000 deficiency records. Based on these files, two documents are prepared and forwarded to agency operating officials. The first is a "Dictionary of Deficiencies" that contains a listing of all current deficiencies, including appropriate classification codes. The second is a "Current Cluster Report" containing a summary of all deficiency transactions, showing totals by functional classification and by major command.

Two other reports are issued. One is a summary of all deficiency reports for the year to date of report, and a second lists deficiencies by operating agencies and major command. All reports are updated and disseminated to appropriate Army management levels on a monthly basis for evaluation and appropriate corrective action.

Thus, the system assists in improved response to audit and inspection data and thereby facilitates the elimination of deficiencies before critical problems arise.

REMARKS. This system utilizes the capabilities of the computer to manipulate and maintain large collections of data. With proper indexing and instructional programs, the computer produces a more meaningful, concise representation of the deficiency items than is possible when conventional methods are used.

DEFICIENCY IDENTIFICATION



1. Reports originate at lowest operating level.

2. Reports are forwarded to Army Data Processing facility in Washington, D.C., for machine processing.

3. Keypunch operators based on code sheet data produce punched cards containing deficiency data.

4. Punched card data is converted to magnetic tape format and placed in film library.

1. Data bank of deficiency data is updated monthly under nine different computer programs.

2. Summary reports of deficiencies are produced as hard copy printout.

3. Hard copy computer printout is reproduced in appropriate format for distribution to users.

Users receive reports automatically, based on current distribution list.

NAME OF SYSTEM:

Engineering Drawings Storage and Reproduction (with Color Overlays)

ORIGINATOR:

U.S. Army Engineer District, Savannah

Corps of Engineers

Savannah, Georgia 31402

OBJECTIVE. To develop and operate a microfilm and half-size construction drawing system that will effectively serve the internal needs of the Corps of Engineers and be acceptable to the engineering-construction community.

BACKGROUND. The Army Corps of Engineers is the largest and most diversified engineering organization in the world. As the primary agency for engineering and construction, the Corps builds structures for the space program and national defense, as well as nationwide systems of civil works for flood protection, harbor development, and hundreds of other essential purposes.

The Savannah Engineer District is principally responsible for the maintenance and improvement of harbors, waterways, and civil works construction within its area of jurisdiction. The major work in support of these varied construction activities is that of engineering design. Responsibility for the district's reproduction of drawings and specifications rests with the Reproduction Branch of the Office of Administrative Services. This activity reproduces original drawings in both paper format and microform. Typically some 70–100 construction projects are supported each year, with each requiring about 80 architectural drawings and hundreds of pages of specifications.

The Reproduction Branch workload has doubled over the last 5 years. Because of this trend, coupled with new and improved capabilities offered in paper reproductions and microform methods, the district has been converting many of the old procedures to improved methods of information handling. Previously, a typical standard engineering drawing was produced on linen or paper and reproduced full-size on a blueprint, whiteprint, or diazo-type machine and distributed as required.

THE NEW METHOD. The system that is gradually being installed utilizes new techniques and equipment to better satisfy economic, operational, and user requirements.

The basic input to the system is construction drawings originated internally or by contract. These drawings facilitate prospective contract documentation by displaying the plan in a graphic form. Prospective contractors are given early notice of planned new construction, and those interested are sent "bid packages" for study and possible bid action.

In support of these contractor requirements, the original drawings are directly reproduced as full-sized or half-sized copies through use of an Itek platemaker and an offset press. The copy reproduction system has the added capability of duplicating the original engineering drawings for use as multicolor, line drawing overlays. For example, a construction drawing can show existing features in black; aboveground new construction in green; and belowground work in red. Thus, in a brief glance, a technician or engineer can readily distinguish between existing facilities and the new work to be accomplished.

After a construction contract has been awarded, the contractor has the choice of receiving one set of drawings in full-size format and an appropriate number of copies in half-size with color overlays.

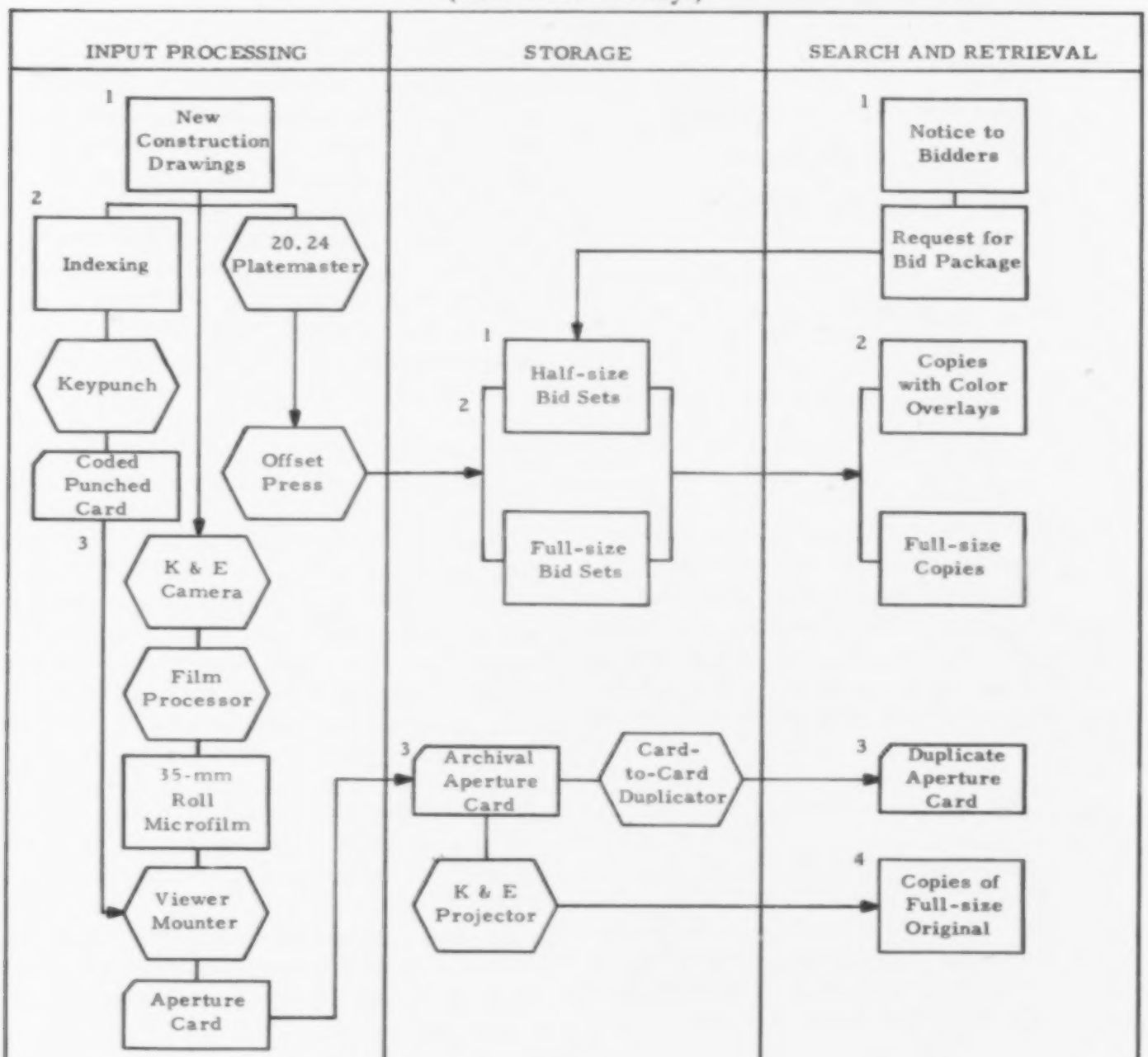
The original drawings are also used to produce archival-quality, 35-mm. silver halide, black-and-white microfilm for mounting on index-coded standard aperture cards. These aperture cards are then used to create duplicate aperture cards using a card-to-card duplicator device. These new sets of cards are used

internally to make full-sized, hard-copy, black-and-white engineering drawing images for manipulation and transmission of information during any redesign phase of existing engineering specifications.

REMARKS. The use of the Itek platemaker for satisfying contractor "bid set" requirements permits reduction of a drawing to half-size paper plates costing about 60 percent less than the full-size prints. This savings is especially significant in terms of a year's production under the half-size format. Some contractors still desire full-size copies, but their number is diminishing as they realize the greater adaptability, legibility, and multicolor advantages of the half-size format.

The use of microform for the reproducing of original engineering drawings is just beginning to be realized. For example, the camera used in such a system, when equipped with a projection or "blow-back" head, will project the archival-quality film image back onto a piece of sensitized drafting plastic and in so doing will reproduce the original drawing in full size. With eradicating fluids and ink, changes can be made on the reproduced drawings to create new originals. Thus this technique can be used to modify existing drawings, rather than having to prepare new ones.

ENGINEERING DRAWINGS STORAGE AND REPRODUCTION
(With Color Overlays)



1. New drawings are processed to produce bid sets in either half-size or full-size hard copy.

2. Drawing data is indexed, keypunched, and converted to punched card data.

3. Original drawings are converted to 35-mm high resolution silver halide microfilm, processed, and mounted on coded aperture cards.

1. Reproduced paper form drawings are assembled into bid sets.

2. Fifty to 75 sets are mailed to prospective contractors and suppliers for each construction procurement. An average of 16 million impressions are produced annually from about 96,000 offset plates.

3. Archival quality aperture cards serve to produce duplicate aperture cards which are used, in turn, to make full-size paper copies of original drawings.

1. Potential bidders for contracts notified of new invitations to bid.

2. Interested contractors receive bid packages for study.

3. Duplicate aperture cards are used internally for study by design engineers. Aperture card images may be studied on reader or reproduced in hard copy format.

4. Full-size copies are used for manipulation and transmission of information during redesign stage of engineering development.

NAME OF SYSTEM:

Correspondence Retrieval

ORIGINATOR:

Naval Ship Systems Command
Department of the Navy
Washington, D.C. 20360

OBJECTIVE. To develop and operate a large volume subject correspondence retrieval system through integration of the document reference search, storage, and retrieval functions into a single unified retrieval system, thus providing a more responsive information service.

BACKGROUND. The Ship Systems Command is responsible for ships, other watercraft, and most nonordnance shipboard material support of the Navy. In performing these duties, the headquarters each day receives about 8,000 pieces of correspondence. About 75 percent of these items are screened and forwarded to other offices for controlled handling. The remaining 2,000 pieces have record and possibly reference value, and thus must be identified as to subject matter and responsibility of action. About 100 inquiries are received each day that require referring to earlier correspondence. Since the information requested could form the basis for making some decision, Central Records must promptly respond to these inquiries.

In support of the above responsibilities, both a manual conventional subject file and a source file were maintained. The source file contained half-size copies of processed microfilm and was filed by the originator of the paper and date. The original document, after being routed and acted upon, was returned to Central Files and either replaced the microfilm in the source file or was filed by assigned subject code. Persons requesting a document had to know its originator and date or its basic subject. Several files were often searched before the document was found. The basic problems of this large filing system were the misfilings, lost documents, and limitations on the types of searches that could be performed.

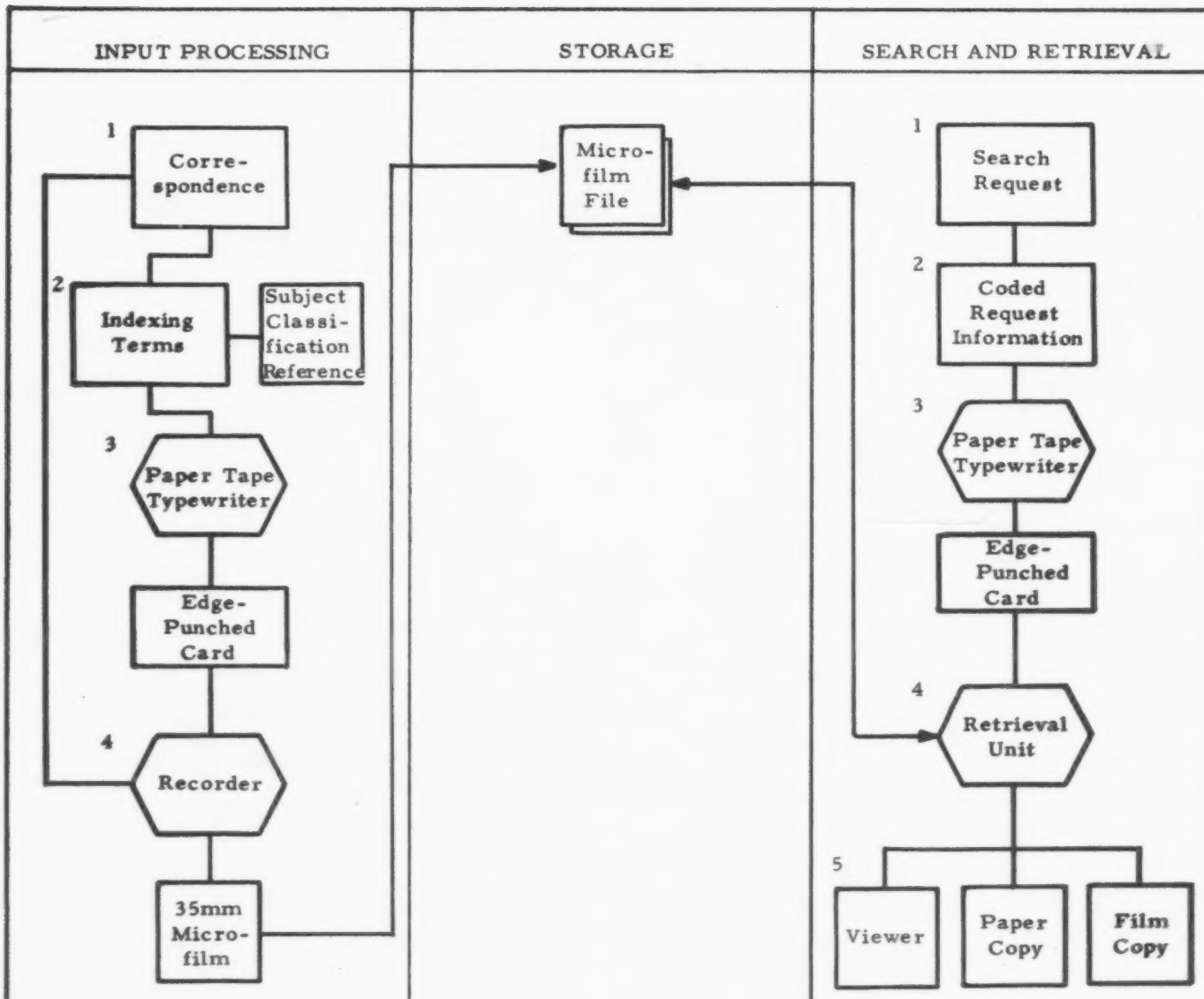
THE NEW METHOD. Incoming documents selected for entry into the File-Search System are first indexed by file station personnel in accordance with an amplified Navy-Marine Corps Standard Subject Classification System. This guidance material permits the documents to be indexed by such identifiers as date, name, addressee, addressor, contract number, type of ship, an a wide range of subject topics. Once the various indexing terms have been determined, a code clerk enters the pertinent indexing information in coded form onto a code sheet. This information is then converted through use of a paper tape typewriter into a machine-language binary code on an edge-punched card. The holes on the edge-punched card thus represent the same data as shown on the coded sheet. The edge-punched card, together with the document it describes, are then placed upon the recording table of a special microfilm camera, and the coded index card is inserted into a slot on the control panel. The insertion of the card automatically triggers a camera recording device that simultaneously produces a photographic image of the binary-coded index data and the document. After development, the resultant roll of microfilm contains both the document and the photo-optical binary-coded index data. The information concerning documents and related index codes is stored on 1,000-foot reels of 35-mm. microfilm that hold 33,000 image pages each.

The processing of requests begins with receipt and "negotiation" of the search question. Once the search question is framed the processing procedures parallel those of the input sequence. First, the search question is coded in machine language. Then, through use of the paper tape typewriter, the resultant edge-punched card is ready for insertion into the File-Search Retrieval Unit. Next, the appropriate reel of coded microfilm is inserted into the Retrieval Unit. Then, with the proper placement of the edge-notched card, the Retrieval Unit will search automatically for documents answering the coded input infor-

mation. Once the match is found, the machine will stop automatically at the selected document image. At this point, three options are available to the requester: he can read the document directly as it is displayed on the viewing screen; he can obtain a hard copy of the image; or he can obtain a film copy of the selected frame through use of an auxiliary copy camera attachment.

REMARKS. This new Correspondence Retrieval System has improved both the breadth and responsiveness of the file search. The system also includes a capability for computer-like manipulation of information due to the programed circuitry of the File-Search Retrieval Unit. Additionally, the file structure may be expanded or modified to meet changing patterns of requests.

CORRESPONDENCE RETRIEVAL



1. Important correspondence covering a variety of topics.

2. Clerk determines index term per Navy-Marine Standard Subject Classification System Guidance.

3. Terms converted to code and paper tape typewriter converts information into binary code on edge-punched cards.

4. Document and binary code on edge-punched card photographed together, developed, and stored on 35-mm phototape microfilm.

Master file of Ship Systems Command correspondence contained on 1,000 ft. reels of index coded phototape.

1. Requester negotiates search question with file technician.

2. Search question coded into machine language.

3. Transforms coded information into binary coded information on edge-punched card.

4. Technician selects proper reel for insertion into the file search retrieval unit. Matching of like binary codes (film and edge-punched card) activates the viewing on display screen.

5. Searcher has three options of output form.

NAME OF SYSTEM:

Failure Rate Data Dissemination (FARADA)

ORIGINATOR:

Fleet Missile Systems Analysis and Evaluation Group

Naval Ordnance System Command

Corona Naval Weapons Center

Corona, California 91720

OBJECTIVE. To operate a technical information storage and dissemination system that will assist in improving the reliability of military hardware.

BACKGROUND. The Naval Ordnance Systems Command, acting for the Naval Material Command, is responsible for material support aspects, including the production of hardware for the entire range of military and space equipment. A specific duty relating to these responsibilities is the monitoring of the reliability engineering aspects in these many space systems.

For many years, hardware reliability reporting was handled on a decentralized basis by various Navy Bureaus. As a natural outgrowth of emerging improvements in methods for gathering, processing, and transmitting information, the Navy several years ago assigned this responsibility to the Data Management Division of the Fleet Missile Systems Analysis and Evaluation Group. Since then the FARADA system has become so meaningful that the Army, the Air Force, and the National Aeronautical and Space Administration (NASA) have been cosponsoring and funding the program.

THE NEW METHOD. The FARADA system collects and disseminates information on the failure rate and failure mode of the various materials manufactured for military and space use. The report breaks down the material into such categories as part, component, module, and assembly. The source data handled within the system emanates from the operational users throughout the military service and NASA. Guidance information for participants includes appropriate forms covering each category of part or mode failure.

Completed forms showing failure rate data are forwarded on a scheduled basis to the Data Management Division, where data is converted to machine language and stored on magnetic tape for processing on a UNIVAC computer. Every 90 days an updated report is produced and sent to users.

The system collection of data comprises one FARADA *Standard Operating Procedure* handbook and five *Failure Rate Data* handbooks. The latter contains more than 38,000 line entries of tabulated failure rate data and 2,000 line entries of failure mode data. Information tables are also kept current on 400 different failure stress curves. Background information is also maintained that describes the more specific aspects of the data displayed, such as location, use, quantities, type of maintenance, and failure criteria. The present growth rate of published and distributed data is about 20 percent per year.

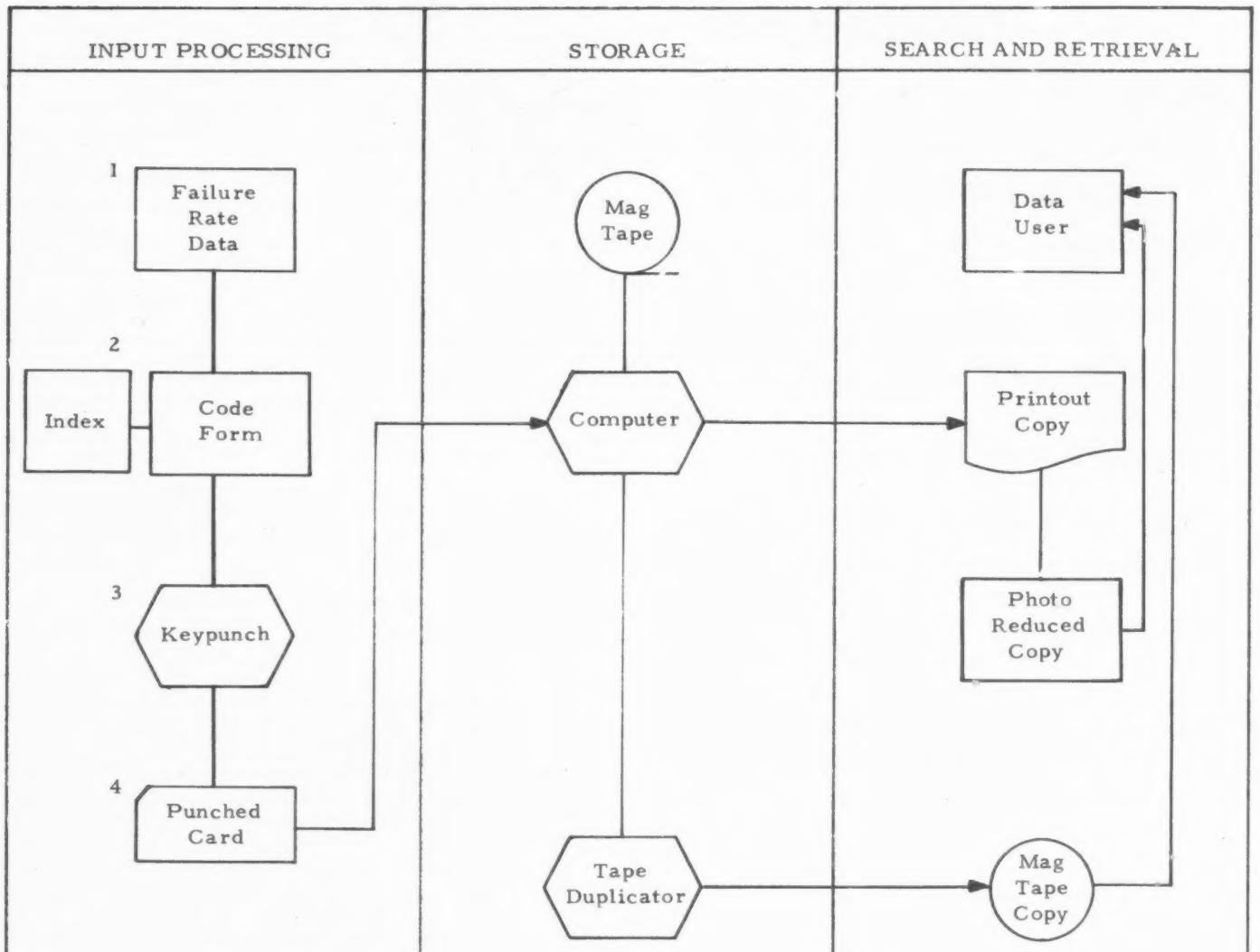
The system's output consists of photoreduced handbook pages derived from computer printout and systems background information pages for insertion into the set of five handbook binders. In addition to paper output format, the entire tabulated data output is available to program participants in the form of computer tapes.

The primary users of the FARADA Program are approximately 250 prime and major subcontractors engaged in either military or NASA efforts. In addition, about 80 Government activities and 15 educational institutions participate in the program as secondary users. The information and data is used by design engineers and reliability engineers in making reliability predictions. Surveys show that 99 percent of the primary participants use the FARADA data in the intended or designed manner.

REMARKS. The computer, with its large memory capacity and its data manipulating ability, is used to good advantage in the FARADA System. The output data needs only to be reduced in size before transmission to the hundreds of users. The ability to provide selected users with magnetic tape copies of data reports eliminates multicopy packaging and the problem of slow mail delivery.

The computer's capabilities greatly aid in improving the reliability of operating systems and equipment, improving logistics planning, and reducing technical data research time.

FAILURE RATE DATA DISSEMINATION (FARADA)



1. Failure rate and failure mode data received from many operating locations.

2. Data is converted to code form.

3. Keypunch operator produces data in punched card format.

4. Punched card data serves as source data entry to computer.

Data stored in Univac tape station consists of a large group of failure rate and failure mode inputs. Data pertains to manufactured parts, components, modules, and assemblies.

Users automatically receive data each quarter in reduced photocopy paper copy or magnetic tape.

NAME OF SYSTEM:

Miniaturized Navy Catalog Data

ORIGINATOR:

Naval Supply Systems Command
Department of the Navy
Washington, D.C. 20350

OBJECTIVE. To explore and develop new and improved methods and procedures for use in disseminating Navy catalog data and to reduce costs and increase the effectiveness of this supply management function.

BACKGROUND. Since 1949, the Navy has disseminated descriptive and management data in the form of printed publications. These publications are distributed to military personnel (requisitioners) located in all parts of the world, as well as to forces afloat, and provide the information needed to effectively manage logistics tasks. Currently, there are 15 separate classes of catalog publications distributed in time cycles ranging from monthly to annually. To illustrate the magnitude of this endeavor, for fiscal year 1971 it is estimated that the printing budget for catalog data alone will total about $1.3 million.

Because of the rising printing and other costs and anticipated increases in the size and number of publications to be managed, the Navy conducted a comprehensive study of the problem. As a result, an in-depth test was conducted to evaluate the feasibility of miniaturizing the catalog data. It was found that most users of the data would prefer a microform system for information storage and dissemination. Accordingly, the Navy has initiated a long-range program that eventually should convert most of the present printed paper catalog publications to microform. As a first step, the Navy has established a microfiche system for designation of selected descriptive management data.

THE NEW METHOD. Among the several catalog classes selected for the initial conversion to microform format is the Navy Management Data List (NMDL). It comprises about 10,000 pages contained in 20 volumes, each about 1-inch thick. About 8,000 NMDL catalog sets are produced. Updating of the NMDL in the past was accomplished by the periodic publication of cumulative bimonthly change bulletins and page revisions, both of which required extensive manual maintenance. When the volume of cumulative changes totaled about 25 percent of the original catalog, or when two years had elapsed, a new updated addition would be printed. Thus, the many changes made it necessary for a searcher to frequently make a double look-up.

The transformation of the NMDL catalog information to microfilm is a relatively simple task under present computer capabilities. Since catalog data is already maintained on magnetic tape, the tape acts as conversion input to the COM (computer output microfilm) microfilm recorder. The COM recorder changes binary-coded information on magnetic tape to readable page images on 16-mm. roll microfilm. The film is cut into strips, and through a series of photographic processing steps, is transformed into a negative microfiche master. The National Microfilm Association (NMA) microfiche format is used. Each microfiche contains 100 page images of catalog information. A microfiche duplicator produces sufficient microfiche copies for distribution to participating ships and stations and shore stations of the Naval Material Command.

The search routine consists of finding the Federal Stock Number (FSN) pertaining to a known NMDL number, which identifies a particular supply item. The searcher first scans the full-size index tabs labeling the approximately 100 microfiche to identify those within the numerical range. Selected microfiche are positioned in the glass carrier of the reader and viewed on the display screen. A scan of the NMDL listings reveals the matching FSN needed to fulfill the search requirement.

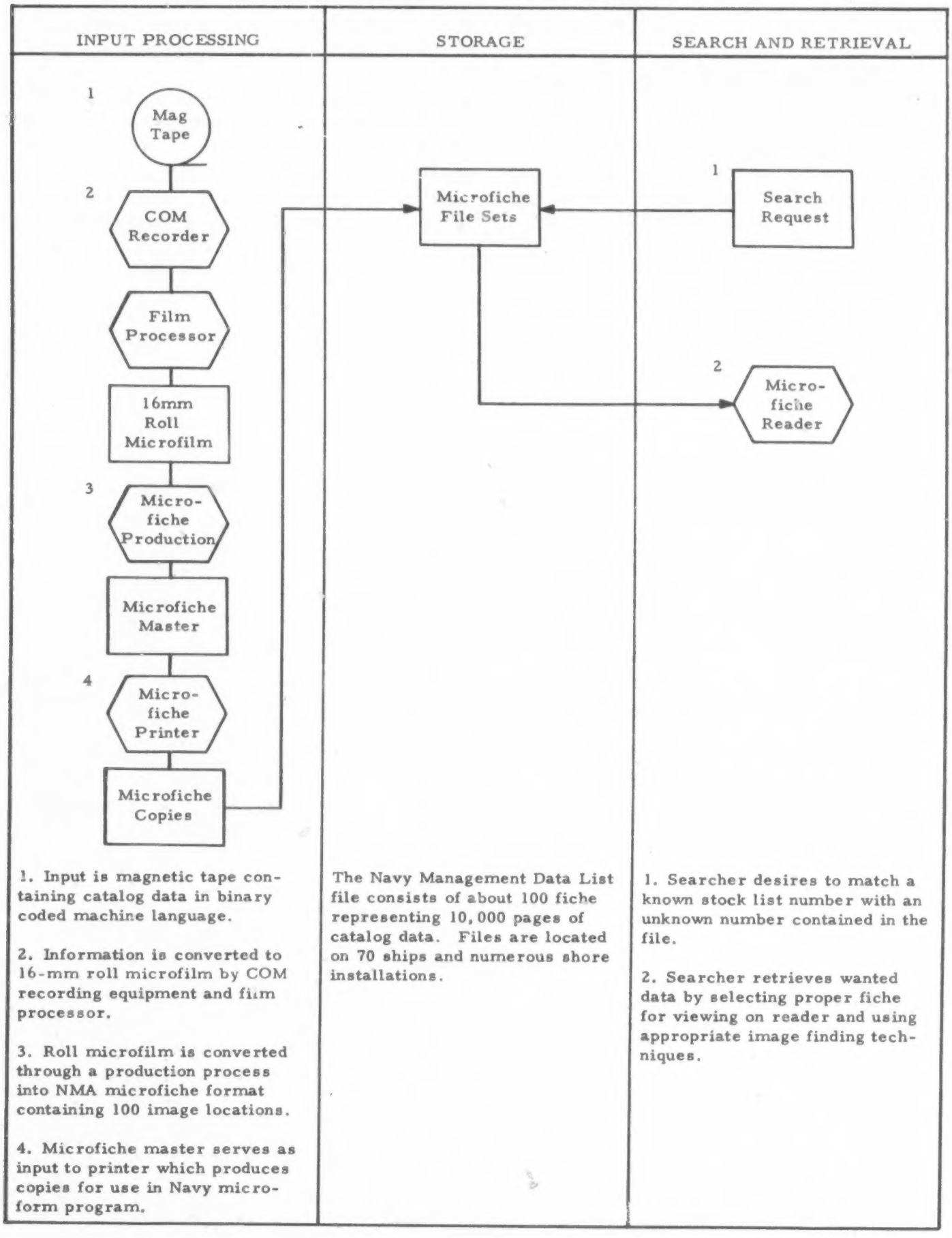
REMARKS. Because the COM microfilm recorder eliminates the computer output bot-

tleneck, it also results in a major cost savings. Recent studies in the data processing service industry have shown that reductions as high as 40 percent in monthly service costs can be realized by using COM in place of computer printout.

Catalog data in microform can be produced in a much shorter time span, and the material is distributed quickly by airmail or first-class mail, whereas bulky catalogs by necessity are usually transported by parcel post. This transmission feature thus narrows the gap between the information accumulation cut-off date and the users receipt of the data.

From the standpoint of user acceptance of this microform system, a comprehensive field test and analysis conducted by the Naval Ship Systems Command showed that over 90 percent of 200 users preferred microform over standard hard copy catalogs for searching.

MINIATURIZED NAVY CATALOG DATA



1. Input is magnetic tape containing catalog data in binary coded machine language.

2. Information is converted to 16-mm roll microfilm by COM recording equipment and film processor.

3. Roll microfilm is converted through a production process into NMA microfiche format containing 100 image locations.

4. Microfiche master serves as input to printer which produces copies for use in Navy microform program.

The Navy Management Data List file consists of about 100 fiche representing 10,000 pages of catalog data. Files are located on 70 ships and numerous shore installations.

1. Searcher desires to match a known stock list number with an unknown number contained in the file.

2. Searcher retrieves wanted data by selecting proper fiche for viewing on reader and using appropriate image finding techniques.

NAME OF SYSTEM:

Public Works Drawings Retrieval

ORIGINATOR:

Public Works Department
Puget Sound Naval Shipyard
Department of the Navy
Bremerton, Washington 98314

OBJECTIVE. To design and operate a document storage and retrieval system that will insure the integrity of the original information and still permit fast access and normal use of the stored information.

BACKGROUND. The Public Works Department of the Puget Sound Naval Shipyard is responsible for the activities associated with changes and modification of buildings, structures, and utilities located on the installation. In support of these matters, the Design Division of the Public Works Department prepares the necessary engineering drawings and insures their safekeeping.

The engineering documents for the smaller shipyard construction requirements are prepared in-house, while those pertinent to larger construction activities are developed either by higher Navy levels or by commercial contract. Developed drawings come under the control and custodianship of the Design Division. Because these large and detailed drawings are often used at some distance from their storage site and are frequently subjected to hard usage at work locations, a better method for control and use of the drawings was needed. An aperture card system was adopted as the best way for preserving the integrity of drawing information.

THE NEW METHOD. The collection of about 53,000 engineering drawings identifies specific elements or features of the shipyard facilities. The reference system is based on local classification features. The main categories include such data elements as assigned facility number, originator's branch code, physical location, and type of work to be performed.

The initial conversion to the standard aperture card format began with the sorting of the engineering drawings into compatible sizes for more effective productivity during the microfilming and image inserting process. The reference information was then placed on a log sheet that governed subsequent processing actions. A copy of the log sheet was used as a basis for data input to the aperture card and assured proper matching of card and microfilm image during the image mounting process.

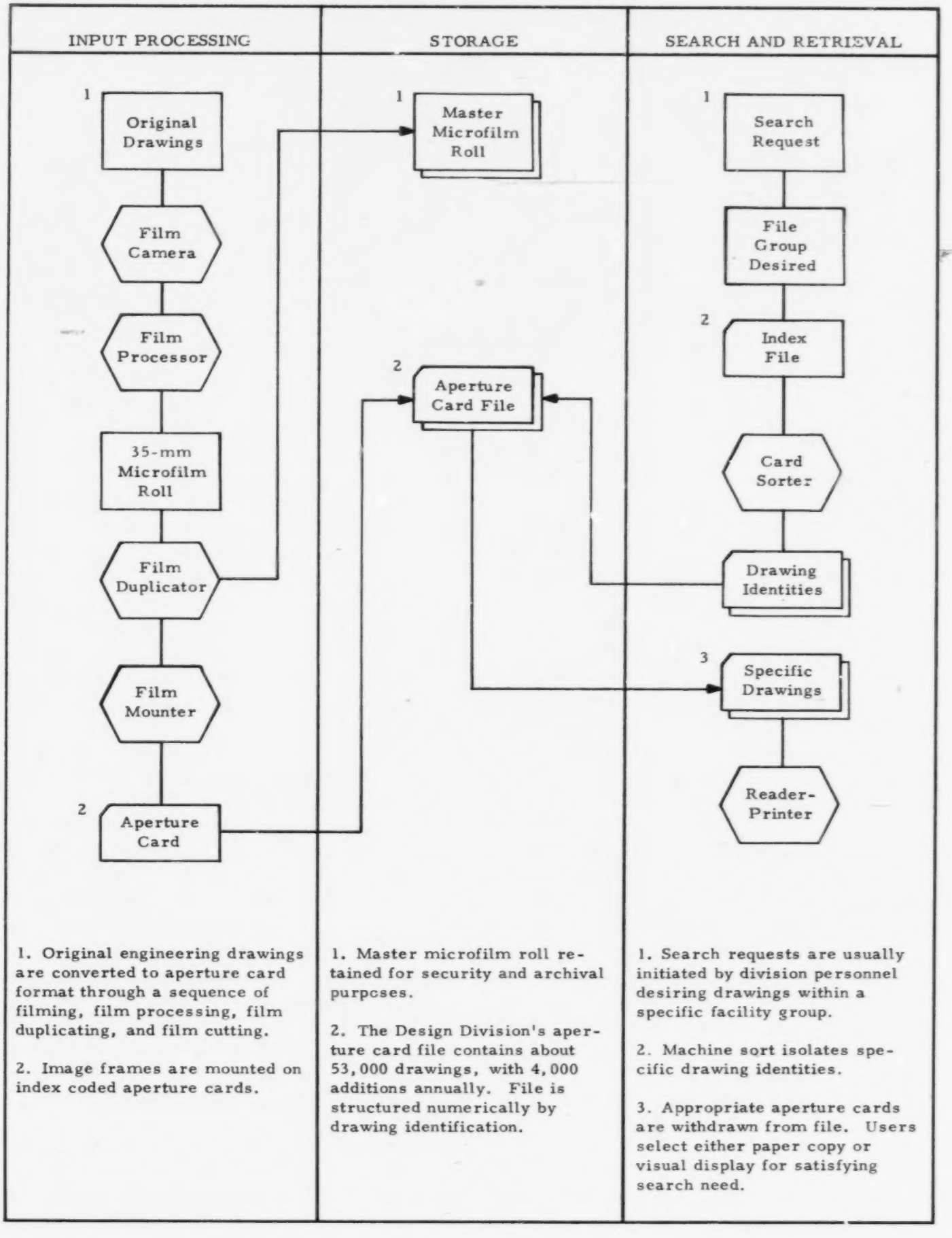
New engineering drawings now entering the system are assigned a facility group or category by the originator, based on the structure's name or identity number. Selected identifying data is keypunched into the punched cards and interpreted (printed) across the top of the card. When more than one facility is involved in a work project, duplicate locator cards are prepared for cross-indexing purposes. These duplicate cards, which do not contain film images, are maintained for machine processing purposes and are commonly referred to as "slave decks." They are filed primarily by facility or group category, followed by the organizational branch to which the facility is assigned.

Engineering drawings are photographed on 35-mm. negative roll microfilm. A microfilm roll duplicate copy is produced for aperture card purposes, and the original microfilm is retained for archival purposes. The aperture cards are filed by drawing number in the Design Division.

Searches for drawings originate primarily within the Division and are handled by an assigned engineering technician. Searching is accomplished by machine sorting of the locator "slave deck" cards and facility grouping. The first sort run will isolate the designated subclass, and where volume warrants additional runs may be made to facilitate the numerical identity of the desired drawings. The appropriate aperture card reproductions of the original tracings are then retrieved from the aperture card file. Users can read the information or produce enlarged paper copies by using the aperture card reader-printer.

REMARKS. This system satisfies the Design Division's objectives of assuring file integrity, and, additionally, the master roll is always available to recreate the original drawing in appropriate size should the aperture card become lost. The system's mechanical sorting capability improves the search process by quickly identifying desired drawings and reducing the possibility that any pertinent drawings are overlooked.

PUBLIC WORKS DRAWINGS RETRIEVAL



1. Original engineering drawings are converted to aperture card format through a sequence of filming, film processing, film duplicating, and film cutting.

2. Image frames are mounted on index coded aperture cards.

1. Master microfilm roll retained for security and archival purposes.

2. The Design Division's aperture card file contains about 53,000 drawings, with 4,000 additions annually. File is structured numerically by drawing identification.

1. Search requests are usually initiated by division personnel desiring drawings within a specific facility group.

2. Machine sort isolates specific drawing identities.

3. Appropriate aperture cards are withdrawn from file. Users select either paper copy or visual display for satisfying search need.

NAME OF SYSTEM:

Allotment Disbursement Record

ORIGINATOR:

Air Force Accounting and Finance Center

Department of the Air Force

3800 York Street,

Denver, Colorado 80205

OBJECTIVE. To establish an improved off-line system for storing, maintaining, searching and retrieving personnel pay and disbursement data.

BACKGROUND. The Air Force Accounting and Finance Center provides technical supervision, advice, and guidance to the accounting and finance functional elements of the Air Force and performs centralized accounting and allotment disbursement functions. In the allotment disbursement activity, more than $1 billion is paid out annually in connection with 14.5 million individual pay transactions. As an example of the enormity of this operation, in 1968 it took 1.8 million pages of 14 x 11 inch special computer printout paper to record payment data. These listings were subsequently decollated and bound in volumes holding 500 pages, with a yearly total of 3,500 volumes.

Inquiries pertaining to allotment matters are received from within the Government as well as by the principals involved. The allotment inquiries are generally concerned with nonreceipt, incorrect amount, wrong name, or loss. An evaluation of the time spent in fulfilling a search request revealed an average of about 2.5 minutes per search, with about 300 Center personnel having access to the voucher records. In the case of many daily telephone inquiries, only 44 percent of the calls could be answered without a followup call.

With the introduction of a second-generation computer system to handle a variety of automated finance systems, not including the check disbursement function, a problem arose relative to the voucher record printouts from the computer. The problem mainly concerned the need to convert digital data quickly and economically into readable form that would be compatible with the computer's other capabilities. The evaluation of various options recommended that a COM (computer output to microfilm) system was the best answer.

THE NEW METHOD. Magnetic tape reels containing the allotment disbursement information are placed on a magnetic tape drive and the data is fed directly into an S. D. 4400 Document Recorder. Through an internal computerized program this equipment converts the magnetic tape impulses into readable characters that are recorded on 16-mm. microfilm. This conversion is performed at the rate of 62,500 characters a second which is equivalent to four computer printout pages of information. The microfilm, after developing, is used to make several negative duplicate copies for use in the Central Inquiry Office. The original copy, after proper treatment, becomes the archival master copy of the allotment disbursement activity. The working copies of microfilm are then cut into 100-foot lengths, placed in the FILMAC 400 system's film cartridges, and taken to the Central Inquiry Office files.

The Inquiry Office operation may be compared to the operation of a data bank. The office contains three sets of microfilmed disbursement records that are housed in rotary, vertical containers. Each of the three search stations is manned by three to four inquiry clerks and contains one file set and two FILMAC 400 reader-printers, plus three or four telephone outlets. The files contain the current three months data, which is updated monthly. Individual cartridges hold about 2,000 pages of information, with 50 individual records per film image. Thus, each cartridge may hold as many as 100,000 records.

All records are arranged numerically by the last two digits of an individual's Social Security number. Cartridges are positioned within the container to visibly show its range of record numbers. The image finding is

performed by the odometer method. Each searcher, having knowledge of both the cartridge's range of numbers and the number and name being searched, is able to estimate the linear position of the record within a few frames. The system is relatively simple and allows most searches to be completed within 15 seconds.

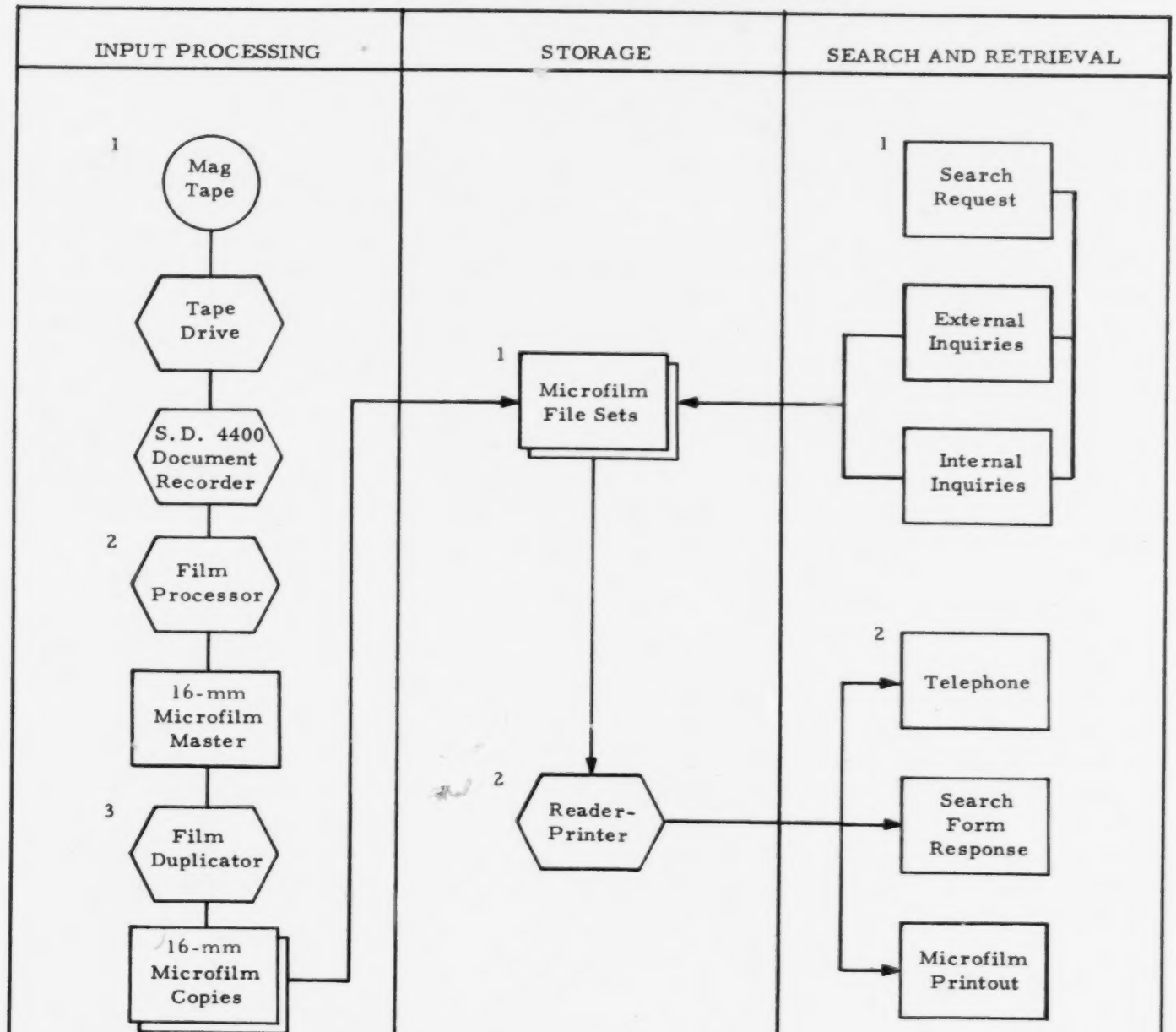
Search actions are generated from external as well as internal sources. The external requests are received by letter or by telephone. All incoming phone calls at the Finance Center's main switchboard are immediately referred to one of the open lines to the Inquiry Office. About 5,000 such calls are received each month. Internal search requests are received via a search request form and are usually acted upon in a matter of minutes.

Once a record is located and placed on the reader-printer, the searcher has three methods of responding to the requester. If requested by phone, the response may be read directly from the reader screen; if requested internally, the answer may be transcribed on a search request form; and if requested by letter, either a form answer or a "half page" hard copy printout of the record may be mailed to the researcher. The hard copy feature of the printer is the most practical since the record requested is only one of 50 contained on each film frame. Usually, all of the search actions can be handled at the search clerk's normal work location.

REMARKS. The principal advantage of this system over the former search methods, in terms of the Accounting and Finance Center's mission, is the much faster response to service member inquiries. Additionally, the following benefits have also accrued as a result of adopting this COM technique:

1. Because of the much faster computer output resulting from this new system, about 500 additional computer hours are now available annually for other applications.
2. Since the system's inception, requirements for more than one million sets of multiple-part, tab paper have been eliminated.
3. The present storage space for active and inactive disbursement records amounts to 1,944 cubic feet. Once the microfilm system completely eliminates the paper records, the space reduction ratio will be 50 to 1.

ALLOTMENT DISBURSEMENT RECORD



1. Allotment check disbursement data contained on magnetic tape in binary form is converted to readable characters on microfilm by document recorder program.

2. Film processor produces 16-mm silver halide microfilm positive.

3. Film duplicator creates duplicate negative microfilm copies which are spliced into 100 ft. rolls and placed in Filmac-400 cartridges and distributed to Central Inquiry Office.

1. Central Inquiry Office maintains three sets of files and three reader-printers to respond to inquiries relative to allotment check disbursement problems.

2. Appropriate cartridges are placed in Filmac-400 reader-printer for retrieval of desired information.

1. Search requests originate with service personnel and dependents or with Finance Center technicians.

2. Responses are passed to the users by telephone, by paper form, or by half-page hard copy.

NAME OF SYSTEM:

Legal Information Through Electronics (LITE)

ORIGINATOR:

Air Force Accounting and Finance Center

3800 York Street,

Denver, Colorado 80205

OBJECTIVE. To permit rapid yet exhaustive searching and retrieval of information contained in the Comptroller General Decisions and other large collections of legal and administrative documents.

BACKGROUND. The office of the Staff Judge Advocate, Air Force Accounting and Finanee Center, Denver, Colorado, first proposed the development of Project LITE as early as 1961. The attorneys at the Denver agency had become aware of certain breakthroughs in automatic indexing and machine searching and believed such techniques would help solve their growing, legal precedent search problems.

Until the LITE system became fully operational in 1964, searches of legal precedent material, such as Comptroller General Decisions and the U.S. Code, were conducted manually. The searches took place at numerous locations throughout the Air Force financial community and involved a duplication of effort. Also, to compound the problem, the body of law and regulatory material was expanding at a rather alarming rate. It was thus obvious to those charged with researching material that emerging new computer capabilities should be investigated with a view toward developing a supplementary, automated data or fact retrieval system.

The system became operational in 1964 after several years of concept development. It included the latest in automated indexing and machine information retrieval techniques. The system is designed to assist procurement officers, attorneys, and other interested users in finding relevant precedent material upon which to base administrative and legal decisions.

THE NEW METHOD. In simplest terms, the search and retrieval processes operate on the information stored in two files within a SPECTRA 70/45 computer, the text file and the vocabulary file. To develop the text file, each word from a document is transcribed to a machine-language mode, such as punched cards or paper tape. This is in turn converted and stored on computer magnetic tape.

With the text file stored on tape, the computer is then used to develop the vocabulary file. This file is basically a concordance or dictionary of all the text file words, with the exception of a standard list of 112 common words. The elimination of these common words from the dictionary reduces the volume of stored controlled text words by about 45 percent. By way of a programed process, each text word within the computer is assigned a text location code. As a result, each word, sentence, paragraph, and document is assigned a serial number.

Users of the system are generally given a short research indoctrination course covering the techniques of problem identification and search framing. The first phase concentrates more on the selection of search words and phrases, while the latter phase is more concerned with the mechanical functions of search. Once competent in using the System, the user has a choice of three output formats: a document citation to include the book volume, page number, scope line, and an abstract reflecting the question; a full page printout of the subject matter requested; or a Key-Word-In-Context (KWIC) printout reflecting the key or prime words appearing in the search request. Users normally submit their inquiries by mail, but they may make their requests by telephone or teletype when necessary.

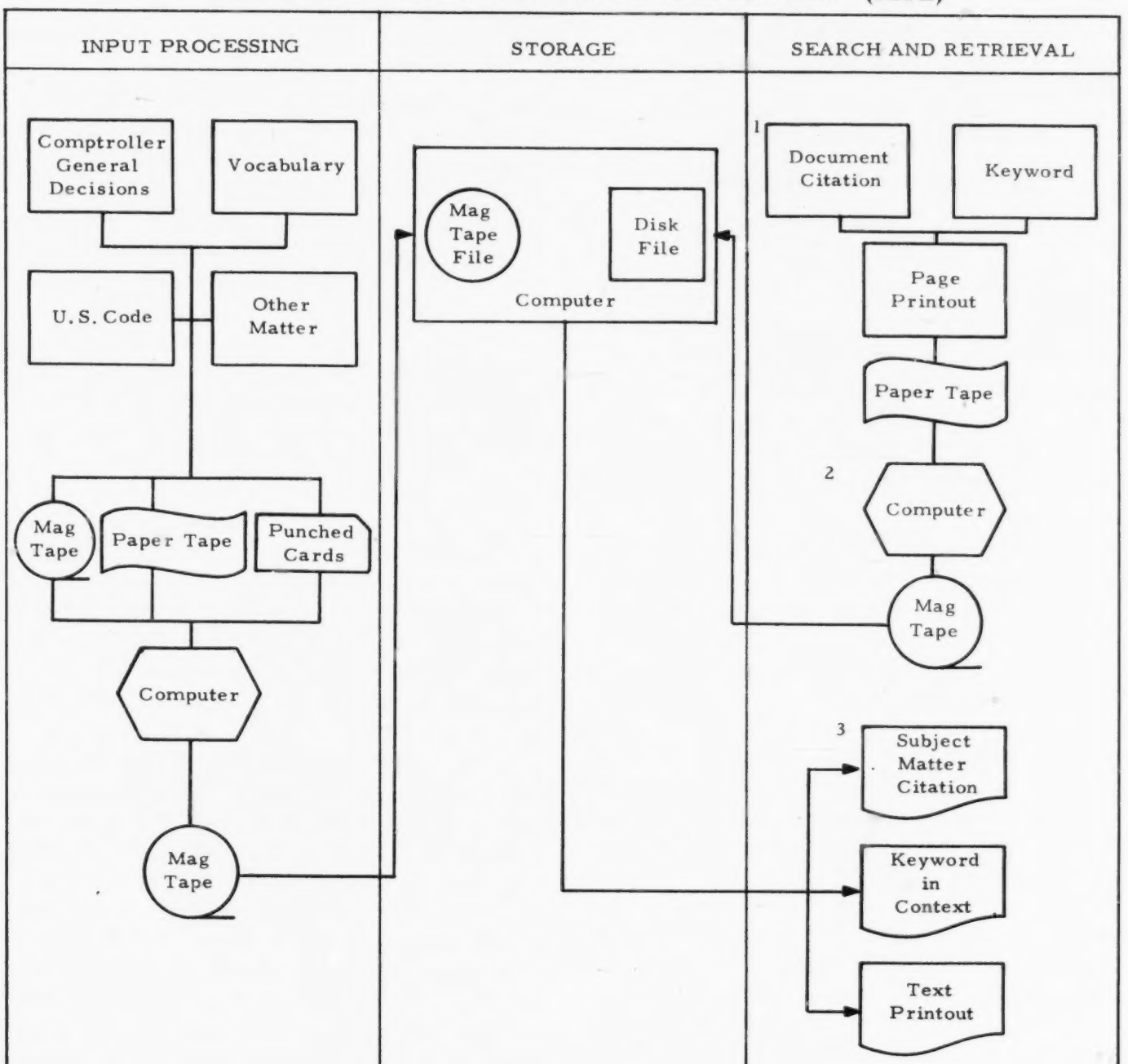
REMARKS. The data bank of the LITE System at Denver is currently categorized into four groups of information—*Statutes* (U.S. Code and Appropriation Acts); *Decisions* (Published Decisions of the Comptroller

General); *Regulations* (Armed Forces Procurement Regulations (ASPR) and Department of Defense Comptroller Directives and Instructions); and *Other,* which includes a wide variety of such documents as the Department of Defense International Law Agreements.

The system offers a wide range of flexibility in search strategy and is limited only by the imagination and ingenuity of those who use it. The initial costs of concept development and text vocabulary files conversion are often higher than costs of other data or fact retrieval processes. However, future costs for retrieval systems of this type should be greatly reduced by the knowledge and expertise acquired through the LITE System experience, by the availability of LITE computer programs for use by others, and by the future use of lower cost input methods, particularly optical character recognition. Further, as more and more installations such as the Comptroller General's Office use computerized composition techniques for preparation of their documents, the magnetic tape created for that purpose can also be used as the input for an automatic indexing and retrieval system.

It is therefore predictable that systems like LITE will play a steadily increasing role in solving the information retrieval problems of the future.

LEGAL INFORMATION THROUGH ELECTRONICS (LITE)



The Comptroller General Decisions, U.S. Code, other selected regulatory matter, and a vocabulary file are converted, if necessary, to coded text on magnetic tape through a series of conversion processes and computer programs.

At the Denver Project LITE facility, the input matter is stored in the computer systems magnetic tape and random access files.

1. Retrieval of information covers three optional formats: citations, keywords in context, and full text printouts of desired information.

2. Search queries are translated into compatible machine language for entry into the computer.

3. Appropriate programing produces requested information in three different formats, per initial address.

NAME OF SYSTEM:

Microform Personnel Record

ORIGINATOR:

Air Force Personnel Center

Department of the Air Force

Randolph Air Force Base,
Texas 28148

OBJECTIVE. To develop, test, and operate a more compact and efficient military personnel records system to meet the current and future demands for greater mobility, faster retrieval, improved controls, and reduction in maintenance costs.

BACKGROUND. The maintenance of the mass of documents required as source data in the Department's Master Personnel Records has become an increasingly serious problem since the Air Force was established as a separate military service.

The mobility of personnel and the need to move records from one file custodian to another and from one location to another have complicated the task of personnel records administration. Centralization of the Master Personnel Records activity has been an objective for many years. Since 1964, a series of long-range studies and analyses has been underway to develop system concepts, design, and hardware requirements. The concepts and basic requirements for a microform system have been completed, and the first stage of a long-range, two-stage program is now undergoing service tests at Randolph Air Force Base, Tex.

THE NEW METHOD. The overall system will eventually contain about 22 million microfiche images of paper records of active Air Force members. Images are appropriately indexed and stored in an image storage retrieval subsystem, with image recall based on automatic random-access techniques. User access to the file is by two-part query display terminals located throughout the Military Personnel Center.

The basic input paper documents enter the system through 16-mm. planetary microfilm camera stations. Documents are photographed in a prescribed order on silver halide microfilm and processed by a commercial microfilm service company. The film roll goes to a production and titling station which, through a series of processes, produces silver halide COSATI (Committee on Scientific and Technical Information) quality master microfiche. Human-readable title data is added at the top of the microfiche by one of several processes. The master microfiche serves as input to a Kalvar microfiche printer where duplicate Kalvar microfiche are produced. The Kalvar duplicates are placed in the working file for use in servicing daily search requests.

The working file is housed in the computerized image storage and retrieval subsystem, which provides random access to designated images. This subsystem, at the direction of the searcher, also transports the desired images to TV cameras, hard-copy printers, or microfiche duplicating printers.

Index entries to the system may be produced in one of two ways. When documents are of a particular standard size they are scanned by an optical character reader (OCR) that records specific data fields on the document. Where documents do not meet size requirements the index entries are typed on bond paper for entry into the optical character reader. The OCR inputs of raw index data are converted to magnetic tape in the same serial order as the corresponding image frames on the roll film. The converted index data is then routed to the computer subsystem for processing and storing until needed to identify appropriate microfiche images.

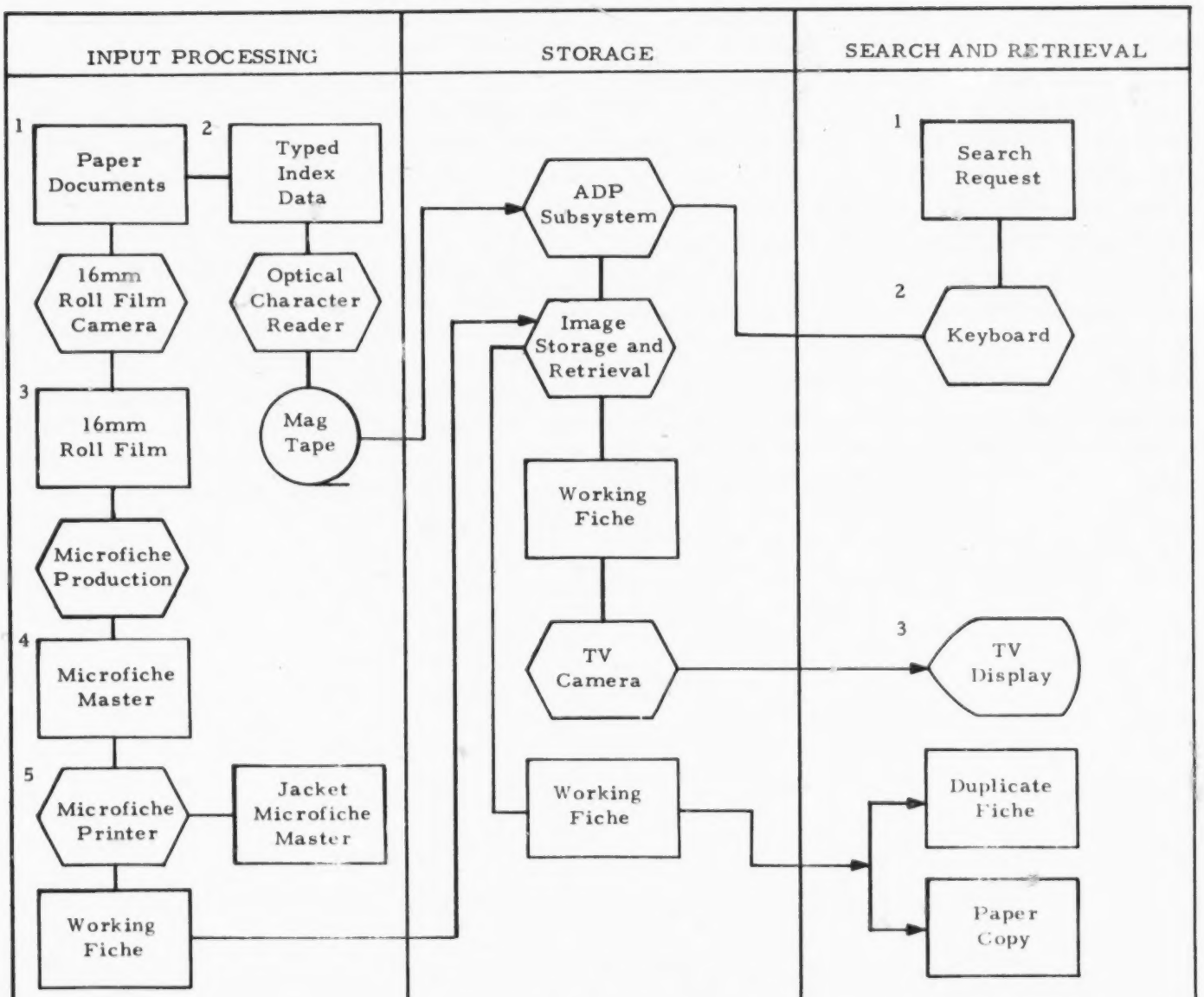
Retrieval of information from the storage file is accomplished through use of teletype keyboards located in user work areas. A user requests a record image microfiche by typing out the serial number of the individual and the subject matter index code in a formalized sequence. The keyboarded message is instantaneously translated by a computer that actuates the image storage and retrieval subsystem to retrieve and position the desired

images in front of an output port of the retrieval system. Assuming that the query results in an image to be displayed, a TV camera scans the image at the output port and transmits the image through the buffer to the TV monitor display location. Each display has an associated keyboard that controls the image selection from the buffer, in addition to display characteristics such as focus and contrast. Should the user desire a hard copy or duplicate microfiche, the image storage and retrieval subsystem routes the microfiche to a different output port where the images are reproduced by an electrostatic printer or where a duplicate microfiche is produced. The copies are then routed to the information user.

REMARKS. This new microform personnel record system utilizes the latest advancements in computer and microform technology to a significant degree. While the system is most costly, the economic and morale benefits should more than pay for the developmental and initial procurement costs within a few years.

The system will greatly reduce the inherent delay in the completion of personnel actions. For example, it should yield valuable benefits in more detailed and responsive management of the individual member; consolidation of personnel records; increased file integrity; and significant reduction in the unit cost of personnel management transactions.

MICROFORM PERSONNEL RECORD



1. Inputs to system are personnel documents, which are photo graphed in prescribed order.

2. Index data is read by optical character reader and converted to magnetic tape by computer action.

3. Roll microfilm is transformed into standard master microfiche format.

4. Microfiche master serves as input to Kalvar microfiche printer. Jacket microfiche master goes to archive file.

5. Duplicates serve as working fiche and are entered into the image storage and retrieval subsystem.

The storage array consists of an ADP computer subsystem for mass storage of index information and an image storage and retrieval subsystem for the storage and control of working microfiche.

1. Serial number requests are entered into the systems through a teletype keyboard located at the user terminal.

2. Input information enters ADP subsystem for specific address identification. Index and location information is passed to the image storage and retrieval subsystem which locates and places information before the TV camera.

3. User may view images on TV display or may obtain a duplicate microfiche image or paper copy.

NAME OF SYSTEM:

Miniaturized Management Reports Distribution

ORIGINATOR:

Advanced Logistics System Center

Air Force Logistics Command (AFLC)

Wright-Patterson Air Force Base, Ohio 45433

OBJECTIVE. To improve current Command information system processes to allow for reduced cost for producing management information and at the same time to provide users with needed information in a more accessible format.

BACKGROUND. The Air Force Logistics Command (AFLC) provides worldwide logistics support to all Air Force organizations. These responsibilities include such complex and vitally sensitive activities as the procurement and maintenance of aircraft and related support systems and the movement and control of supporting material. In addition to the headquarters, five subordinate installations called Air Material Areas are responsible for performing the necessary activities in support of the overall mission. In the management of these multibillion dollar programs, AFLC for many years has been one of the larger users of automated information processing equipment and techniques. During this period, the Command has also been a leader in the exploration and use of appropriate technological advances.

As both the scope and number of computer-based management reports increased over the years, two output problems have become increasingly apparent. One has to do with the growing imbalance between actual machine processing speed and the rate of impact printer output in the form of master copy printout. The other concern involves the enormous increase in the volume of printed reports—over 32 million original pages were produced during the past year. An interim solution to the processing versus printout imbalance has been to employ IBM 1401 computer systems to relieve other computers—principally the IBM 7080—of massive print workloads. The bank of 1401 computers print output information based on magnetic tape input at the rate of 600 lines per minute on an around-the-clock schedule.

THE NEW METHOD. The new microfilm display system should become operational during fiscal year 1971, with similar equipment and procedures being used at each of the six locations. The new system will record output from the AFLC's computer processing equipment directly onto 16-mm. microfilm by means of COM (computer output microfilm) equipment. Peripheral equipment to support the new concept will be used for film processing, film duplicating, and for viewing the microfilm output.

Specifically, magnetic print tape will be the input to the off-line microfilm recorder. It will convert and record data information to human-readable images on 16-mm. microfilm, within the range of 7 to 15 thousand lines per minute. This conversion performance is in contrast to the current hard copy recording capability of 600 lines per minute. The film processor, normally working in direct line with the recorder, fixes the exposed film for permanent use. The first off-line process will entail the duplicating of the master microfilm copy in copies sufficient for distribution to the groups of users. After these duplicates are loaded into cartridges they will be forwarded to the several file stations where either readers or reader-printer equipment will be available for screen viewing or for the making of paper copies.

REMARKS. The system's cost over a five-year projection should annually average 14.2 percent less than current costs for labor, supplies, mailings, and both data processing and nondata processing equipment.

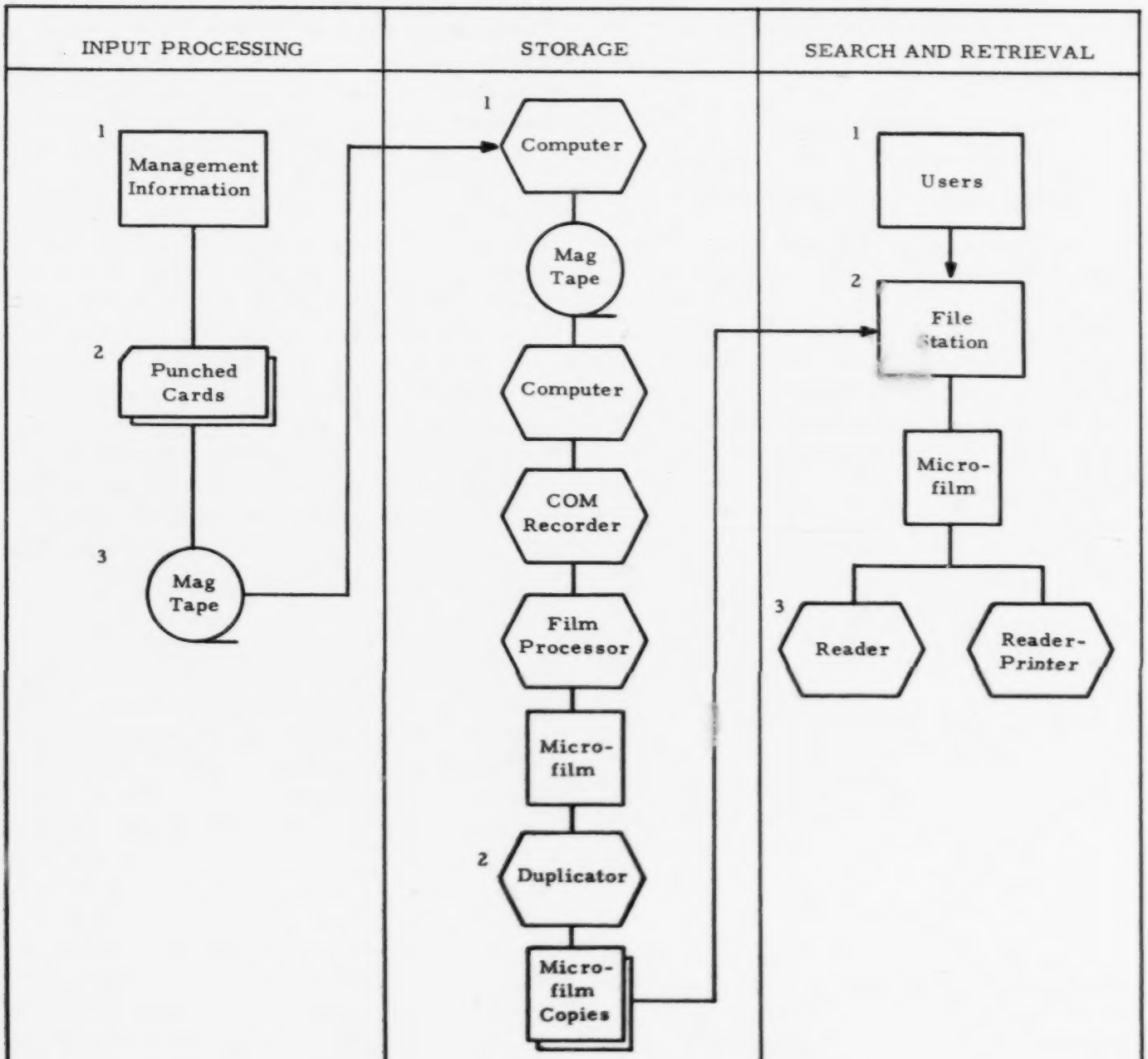
An analysis of paper information display versus microfilm image display revealed that the microfilm costs should range from 13 to 20 percent less than paper costs for the same number of information copies.

Considerable savings in paper will accrue since many users of the management reports are only interested in a small segment of the full report. Hence, the system can be tailored to the needs of individual users through selective storage of microfilm cartridge information at the file stations. When the six duplicate systems are fully operational, more than two tons of computer printout paper will be eliminated annually.

Other significant benefits will be realized through the conversion of about 34 million pages of printed paper files to microfilm, including easier storage and handling and increased efficiency for users.

Service tests revealed that the majority of users desired their information on microfilm rather than on paper printouts. However, some negative reaction concerned two aspects of the microfilm reading equipment—design and environment. Some users experienced discomfort such as eyestrain, headache, and neckstrain. To modify or eliminate these problems, system specifications will acknowledge the need for less screen glare on readers and a more compatible lighting environment. Additionally, the acquisition of adjustable-height stands for readout equipment will be considered.

MINIATURIZED MANAGEMENT REPORTS DISTRIBUTION



1. Prepared manually by many individuals throughout the command. Based on hundreds of feeder reports.

2. Information translated into machine language by many code clerks and typists.

3. Punched card information converted to input magnetic tape.

1. The magnetic tape is converted to human-readable form by conversion to print magnetic tape and then to 16-mm microfilm.

2. A microfilm duplicator makes additional copies for file stations.

1. The management reports are used by many levels of management throughout the command.

2. Reports are stored in microfilm roll cartridges at the many file stations.

3. The user may either view information on a reader screen or obtain an enlarged paper copy from the reader-printer.

NAME OF SYSTEM:

Office Files Coordinate Index

ORIGINATOR:

Office of Scientific and Technical Information

Office of Aerospace Research

Department of the Air Force, Washington, D.C. 20330

OBJECTIVE. To evaluate several nonconventional document reference systems, with a view toward implementing the method that shows the best promise of improving office-level document identification and retrieval processes.

BACKGROUND. The Office of Aerospace Research is a separate operating agency answering directly to the Headquarters, United States Air Force. It conducts and supports research relating to the Air Force's operational capabilities. It can therefore be seen that the proper handling of office corespondence and technical documents is most important to the overall effectiveness of this organization. Its scientifically-oriented document collection mainly includes professional papers, technical reports and proposals, and journal articles on research matters.

The conventional hierarchical subject classification system was not particularly well suited to the needs of the office, and therefore it was decided to explore other techniques for organizing the files. It was concluded that a rather simple nonconventional coordinate indexing system would satisfy this goal. It was further decided to attempt to use regular office personnel to operate the system, although systems of this type customarily employ professional indexers. To determine the feasibility of this, a period of on-the-job evaluation of coordinate indexing methods was conducted using available office personnel—clerks, stenographers, and secretaries—to perform all tasks. The test was successful, and the Office of Scientific and Technical Information established a columnar card, coordinate indexing system on a permanent basis.

THE NEW METHOD. The physical elements of this columnar card system consists of an overprinted 5 x 8 inch index card and a loose-leaf binder containing a vocabulary of commonly used words (indexing terms). The columnar index cards, called word-cards, contain ten vertical columns numbered consecutively from 0 to 9 for use in entering the numbers of the accessioned documents. The last digit of the document's number determines the column to which that number is posted. The only purpose of the columnar format is to assist in scanning for identical document numbers. The vocabulary is a form of translation dictionary that contains words commonly known and frequently used in correspondence or by searchers in describing desired correspondence, with cross references for synonyms. A word-card is placed in the card file for each authorized indexing term contained in the vocabulary.

The input processing sequence is relatively easy to learn, and in the case of this system is usually performed by an office secretary. Each incoming document is first reviewed to determine whether it should be accessioned or discarded. If retained, it is assigned a document number. It is then scanned or read to identify key terms. The key terms thus selected are checked against the approved vocabulary word-list to determine, in each instance, what term should be used for actual indexing purposes. The columnar word-cards representing these approved terms are then withdrawn from the card file and posted to show the newly accessioned document's identity number. The document is then placed in the serially numbered document file and the columnar word-cards are returned to their alphabetical position in their file.

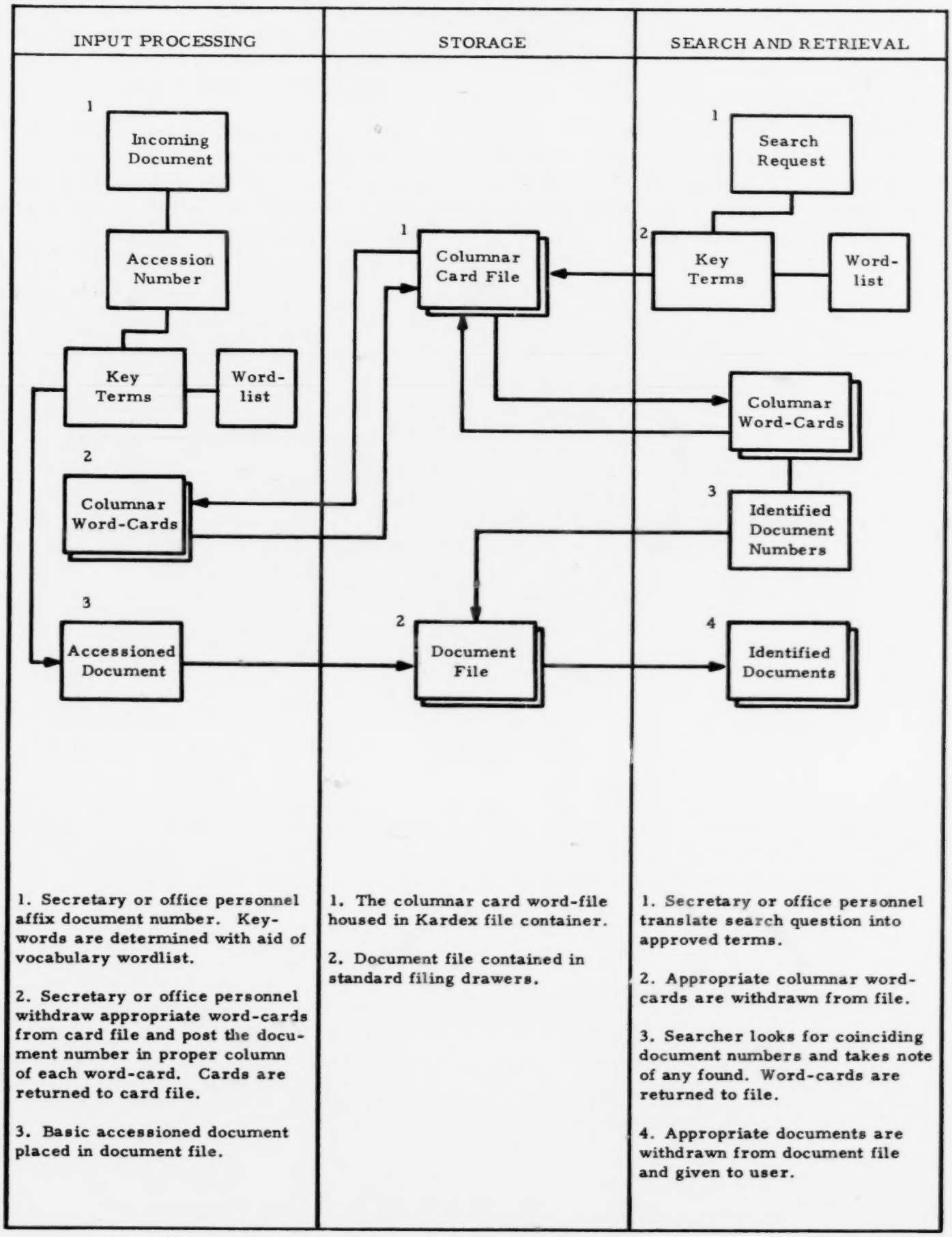
In the retrieval process, a secretary is usually given several descriptive words pertaining to the document sought by the user. Through use of the vocabulary word-list, she translates those initial words, where necessary, into the actual indexing terms used in the system. She withdraws the cards representing these terms from the columnar word-card file and compares document numbers on

all cards, column-by-column, for coinciding document numbers. The material thus identified is withdrawn from the document file and given to the requester.

REMARKS. This columnar card, coordinate indexing system well serves the objectives of the sponsoring office. The method represents the simplest and least expensive of the nonconventional reference systems in terms of equipment and maintenance costs. In this particular situation, regularly assigned office personnel were able to quickly learn the principles and procedures required to handle and index office correspondence.

With proper planning, conversion from a conventional, multisubject filing system to a coordinate system of this type can be accomplished with little disruption in day-to-day operational effectiveness.

OFFICE FILES COORDINATE INDEX



1. Secretary or office personnel affix document number. Keywords are determined with aid of vocabulary wordlist.

2. Secretary or office personnel withdraw appropriate word-cards from card file and post the document number in proper column of each word-card. Cards are returned to card file.

3. Basic accessioned document placed in document file.

1. The columnar card word-file housed in Kardex file container.

2. Document file contained in standard filing drawers.

1. Secretary or office personnel translate search question into approved terms.

2. Appropriate columnar word-cards are withdrawn from file.

3. Searcher looks for coinciding document numbers and takes note of any found. Word-cards are returned to file.

4. Appropriate documents are withdrawn from document file and given to user.

NAME OF SYSTEM:

Technical Data Dissemination and Retrieval

ORIGINATOR:

Warner Robins Air Material Area

Air Force Logistic Command

Department of the Air Force

Robins Air Force Base, Georgia 31093

OBJECTIVE. To evaluate and implement a microform image storage and retrieval system that will more effectively serve the technical data needs of maintenance technician personnel.

BACKGROUND. Warner Robins Air Material Area (WRAMA) is one of five logistic facilities within the Air Force that provides material support to its operating units throughout the world. This support encompasses such activities as supply, material maintenance, and procurement. WRAMA specifically is responsible for the logistic management of a variety of component systems such as tactical missiles, helicopters, and small aircraft.

Because of the technical nature of this mission large quantities of instructional material are produced. For example, the organization's technical data system contains about seven million pages of instructions, which are contained in 70,000 publications. During an average year more than two million page changes to the basic instructions are necessary to keep the information current. To maintain this data in reasonable order, 90 file areas or stations are located throughout the base complex of work areas that service particular types of material.

Success of WRAMA's maintenance mission is dependent upon accurate, complete, and current technical data. A study of the growing problem isolated three main areas of concern. These were the lack of technical manual file integrity, the failure to provide data in a form convenient to the user, and the high cost of maintaining files. File integrity was found to be the most serious deficiency. Requisitions were often back-ordered, mail was frequently delayed, and revisions were sometimes not received or were misplaced. Obsolete instructional data delayed technicians in accomplishing maintenance task assignments while awaiting receipt of a current directive.

As a result of these findings, in early 1969 WRAMA conducted a 4-month service test with 400 individuals to evaluate the feasibility of employing microform to eliminate the deficiencies. The test conclusions showed that "microfilming of technical data should prove highly beneficial in all areas, including cost reduction." As a result, WRAMA is currently expanding the use of microfilm to other work areas. Because of the magnitude and operational impact of this undertaking, full conversion will not be completed for several years.

THE NEW METHOD. Technical data material, in page form, is arranged sequentially for recording on 16-mm. microfilm by a Recordak 600-K microfilmer. The film is developed in a Recordak Prostar processor, and diazo negative roll copies are then produced on a CBS (Columbia Broadcasting Company) continuous film duplicator. The microfilm is cut into 100-foot lengths and loaded into cartridges intended for use with the 3M 400-C microfilm reader-printer. The cartridges are indexed and labeled to show the segment of the technical data material each contains.

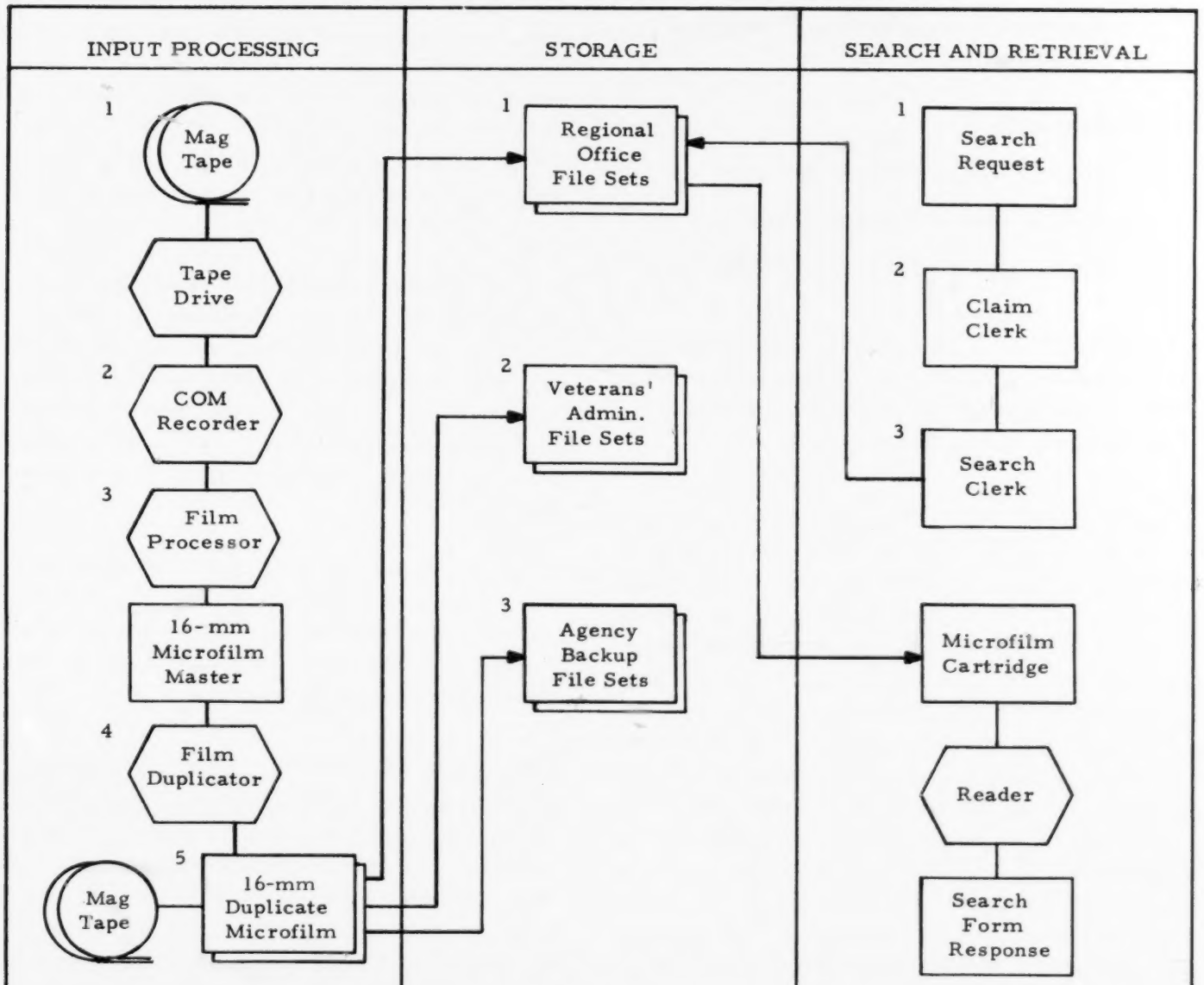
Cartridges are distributed to work area file stations, and upon receipt the obsolete cartridges are returned to the data manager's office. Revision data cycles average 45 to 60 days and depend upon the data change frequency within a particular type or class of material data.

The mechanic or other interested individual has the option of viewing page image data on a reader or of obtaining an enlarged paper copy for use at his work location. Battery-powered portable readers are available for use at remote sites such as engine run-up

facilities and area support sites. Image finding is accomplished by the odometer technique wherein individual images are manually located on the viewer on the basis of their linear location on the roll.

REMARKS. The primary advantage of the use of the microform rather than manual means of technical data display is the concept of one data manager being responsible for a given set of microfilm data cartridges. The responsibility for updating the master data package, for assuring that data is current and complete prior to filming, for reviewing the master film and duplicates, and for distributing required cartridges rests with one individual. This concept provides a single contact between material class managers and various users of the data and proves most beneficial to file integrity. Data integrity is further enhanced by the system's ability to cut reaction time to data changes by about one-half.

TECHNICAL DATA DISSEMINATION AND RETRIEVAL



1. Check issue records data in magnetic tape format forwarded weekly by disbursement office regions to Chicago disbursement region by airmail.

2. Magnetic tape converted to readable characters on microfilm by COM recorder program.

3. Film processor produces 16-mm silver halide microfilm positive.

4. Duplicator produces microfilm negative copies which are spliced into 100 ft. rolls and placed in cartridges.

5. Magnetic tapes and duplicate microfilm cartridges are airmailed to originating offices.

1. Each of eight regional disbursement offices maintain microfilm file sets of check issue records for reference purposes.

2. Duplicate sets of check issue records pertinent to the Veterans' Administration payees are forwarded to 55 VA regional offices.

3. Additional check issue record microfilm sets are forwarded to other agencies as backup for security purposes.

1. Search requests originate with people concerned about check status.

2. Claim clerk records pertinent search data.

3. Search clerk identifies and places proper microfilm cartridge in reader and records data. Search clerk returns search form with appropriate data to claim clerk who then responds to concerned individual.

NAME OF SYSTEM:

Microform Engineering Drawings Support

ORIGINATOR:

Marine Corps Supply Activity

United States Marine Corps

Philadelphia, Penna. 19146

OBJECTIVE. To provide a microfilm system that will effectively support the inventory control and procurement functions of the Marine Corps Supply Activity.

BACKGROUND. The Marine Corp's Supply Activity at Philadelphia has been providing logistic support for the Corps since Thomas Jefferson's administration. Although certain supply and logistics services (especially catalog standardization), have been transferred to the Defense Supply Agency, the military services manage material and support items peculiar to their individual needs. Thus, the services develop their requirements, arrange for the procurement of specified material and supply items, and insure that adequate inventory levels are maintained to meet projected usage. The Supply Activity at Philadelphia performs this vital function for the Marine Corps.

Among its many diverse duties, the Inventory Management Activity is responsible for maintaining a library of technical reference information on material and supply items used by the Corps. Engineering drawings form an important link in this management process and serve as a focal point for the provisioning, cataloging, and procuring activities. As new items enter the inventory for the first time, the contractor furnishes appropriate engineering drawings for use in the provisioning and cataloging process. Later, when subsequent invitations to bid are required, sets of pertinent drawings support the procurement process.

For many years, drawings used for procurement actions were reproduced in hard copy paper form and in many different sizes. As specifications for new items became more complex, the supporting drawings necessarily increased in number. Further, broad interest in some procurement actions created the need for multiple bid sets. These developments, plus the increase in space needed to house the drawings inventory, precluded any early, satisfactory solution.

The space problem was eliminated with the conversion of the engineering drawing inventory to aperture card format. However, bid sets in support of procurement actions continued to contain reproduced paper enlargements of aperture card engineering drawing images and slowed down the processing action.

As the use of aperture cards and associated equipment increased throughout industry, the inventory management activity has expanded the use of microform to all phases of the engineering drawing operation.

THE NEW METHOD. The improved system is designed particularly to improve the reaction time in procurement actions. Manufacturers' inputs to the system consist of both full-size paper copies of engineering drawings and aperture cards, as provided in the contract. The Defense Supply Agency (DSA) furnishes aperture cards in the standardized format with prepunched identification codes.

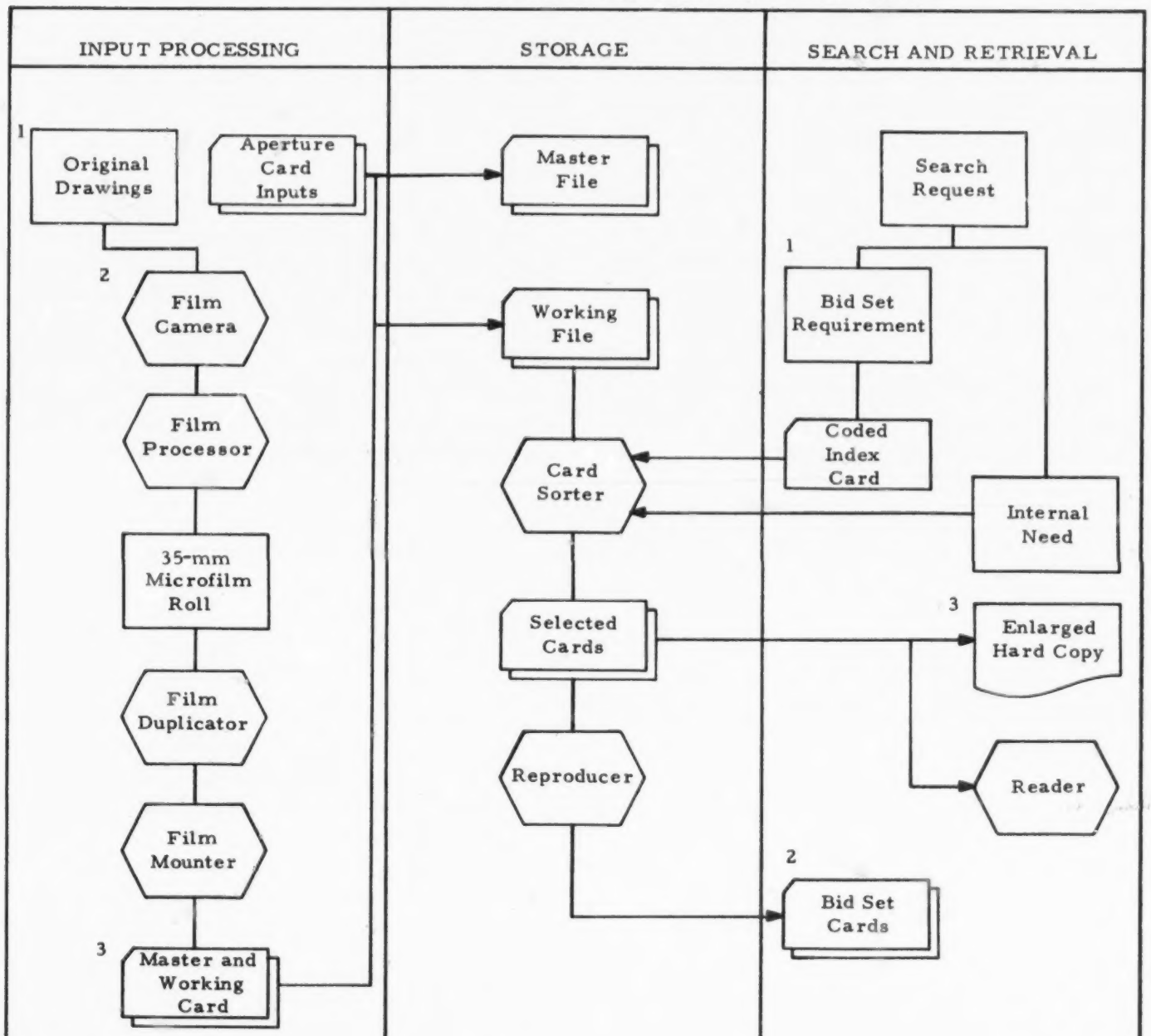
Drawings received in paper format are sorted into compatible sizes and recorded on 35-mm. microfilm. The exposed film is developed in a microfilm processor, with a Uniprinter used to make duplicate negatives. Both manual and semimanual devices are employed to mount the individual frames in the coded aperture cards, which are keypunched to permit machine sorting and other manipulations. The keypunch coding includes the standard engineering drawing number and the manufacturer's five digit identity, which facilitates interchange of filmed drawings with other agencies. Duplicate microfilm positives are used in the working file with the original negatives preserved as the master file.

The present collection numbers about one million cards housed in conventional upright file cabinets. To satisfy bid set requirements, a machine sorting program using coded index cards identifies the aperture card drawings pertinent to a procurement action. The selected working aperture cards are then duplicated on a 041 card-to-card reproducer and verified for accuracy. The working cards are returned to the file and the reproduced cards are enclosed in the total procurement package and mailed to prospective bidders.

Internal searches, usually at the request of technicians, deal with maintenance, provisioning, and cataloging matters and may require working size hard copy printouts, which are produced on an enlarger-printer. In other instances, technicians may wish to study the data by means of an enlarged image on a viewer.

REMARKS. The use of microform in aperture card format has contributed significantly to the faster and more economical methods of satisfying both internal and external requirements of the Marine Corps Supply Activity. The system illustrates the space saving advantages as well as the flexibility and convenience of collecting, packaging, and shipping large numbers of engineering drawings—often on a limited time schedule.

MICROFORM ENGINEERING DRAWINGS SUPPORT



1. New drawings for inventory collection submitted by contractors in original form.

2. Drawings are converted to aperture card format through series of production processes.

3. Aperture cards initially received and those produced in-house are placed in respective files.

Master and working file contains about one million drawings in aperture card format.

1. Search request initiated to fulfill procurement requirement for engineering drawings, or for internal management needs.

2. Bid set requirements are met through series of processes that select and produce pertinent duplicate sets of aperture cards.

3. Internal requirement is satisfied by obtaining data from enlarged paper copy or by viewing on reader.

NAME OF SYSTEM:

DDC Information Storage, Dissemination, and Retrieval

ORIGINATOR:

Defense Documentation Center (DDC)

Defense Supply Agency

Cameron Station, Alexandria, Virginia 22314

OBJECTIVE. To maintain and operate a centralized national documentation dissemination and retrieval service for the scientific and engineering disciplines, in order to improve the utilization of research reports and the effectiveness of Government research and development activities.

BACKGROUND. The Defense Department (DOD) must spend several billion dollars a year on research, development, testing, and evaluation of new operational and support systems. As a by-product of these thousands of individual programs, an avalanche of technical reports are produced. Collectively, there is a treasure of scientific and technical information among these many documents. A major problem in the design of any information collecting, processing, and disseminating system is the need to channel the required information to the interested persons as efficiently and effectively as possible.

To better understand user characteristics, the DOD undertook a comprehensive study of the problem by interviewing many users of the information. The sampling encompassed about 1,350 of the more than 100,000 scientists, engineers, and technical people involved in Department of Defense research and development work. The investigation revealed that, as for type of information interest, almost half desired engineering information while about 40 percent had scientifically-oriented interests. In regard to the depth of the information need, 60 percent wished specific facts, perhaps from one document, while about a third of those interviewed desired enough material to make detailed analyses.

In terms of information system utilization, about 95 percent of the users relied upon their organizational technical libraries, with most agreeing that abstracts of information media would have been useful in completing past projects. About one third of the users utilized the DDC, while the remainder, at the time of the interview, were unaware of its services.

THE NEW METHOD. The Defense Documentation Center collects, processes, announces, and distributes scientific, engineering, and technical information to personnel of the Department of Defense and related agencies and activities. Documents processed and distributed by this system fall into the subject categories listed in the COSATI (Committee on Scientific and Technical Information) Subject Category List, which covers 22 scientific and engineering fields.

The full collection of research and development documents dates from 1947 and totals about one million accessions. The descriptive data for accessions acquired since 1953 is stored on magnetic tape and is computer-retrievable. All documents are microfilmed as they are processed into the system. Those documents received before 1965 are stored on 35-mm. roll microfilm while the later acquisitions are reproduced in microfiche. The microfiche is used to reproduce hard copies for prestocking and to meet user needs. Incoming documents are arranged by a six digit AD number in consecutive order within three separate blocks of numbers, which are based on classification needs.

Document analysis processing includes descriptive cataloging, subject categorization, subject indexing, and abstracting, which is accomplished by means of remote input terminals. The objective of this treatment is to bring the technical report literature under bibliographic control and to simultaneously produce input data for processing into the computer record.

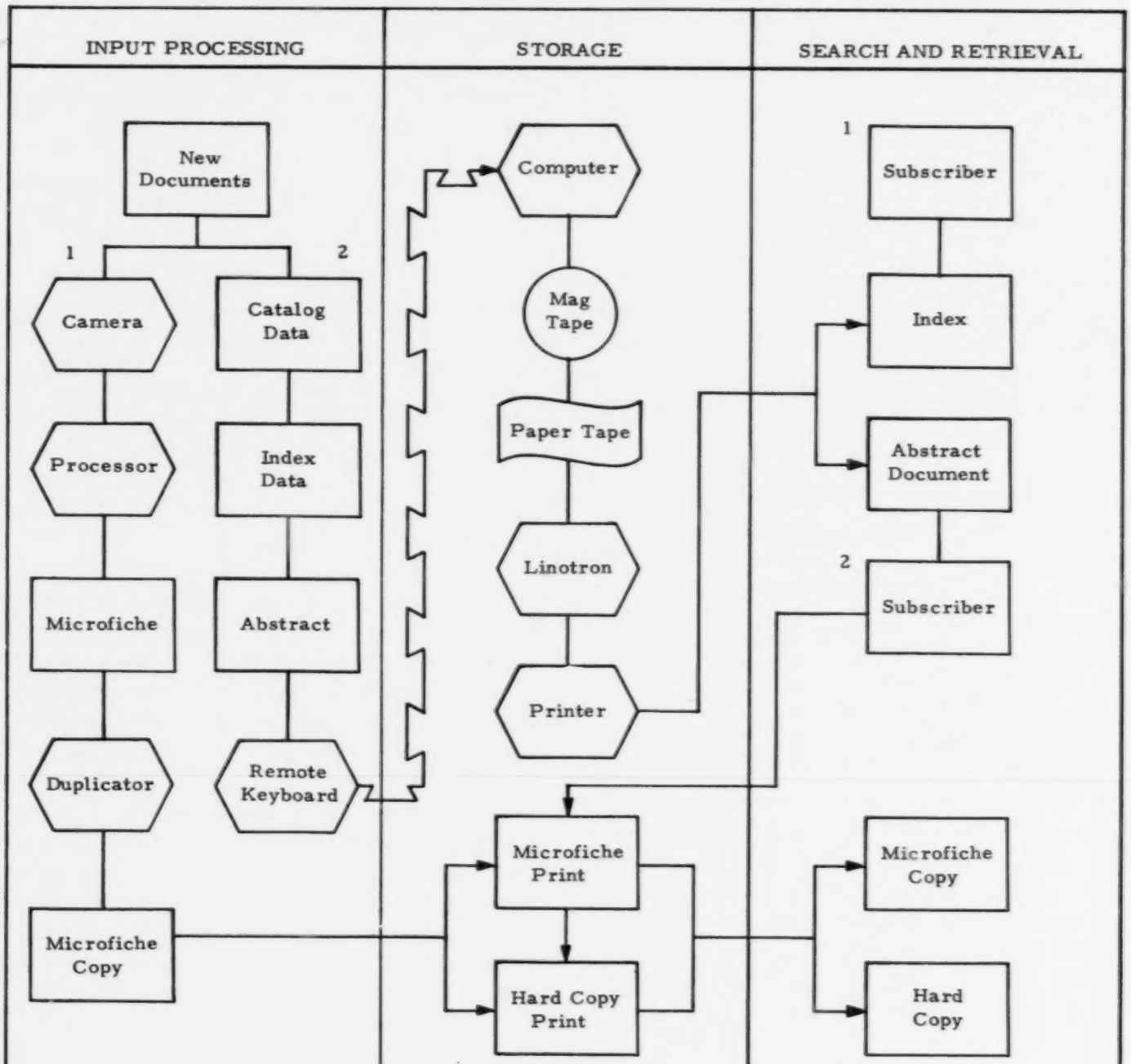
Documents are categorized under as many as 13 characteristics that are machine-stored for subsequent retrieval. Characteristics include corporate author entry, personal author, and the source report number.

The Technical Abstract Bulletin (TAB), together with its companion TAB indexes, are published semimonthly and announce new accessions to a limited group of users. Should these subscribers desire a copy of the document they may choose between hard copy or microfiche format. (By special arrangement, DDC will furnish magnetic tape containing cataloging data covering current accessions.)

REMARKS. The objective of this system is to provide the right information to the user at the right time and in an economically acceptable format. It is the largest and the most used system of its kind anywhere in the world. A first step in meeting these responsibilities is to understand users' needs and then to establish procedures that will fulfill their requirements.

DDC is continuing to take actions within the processing framework to reduce the time for document information to reach users. For example, during the past year the time span between initial receipt of documents by the DDC and the receipt of abstracts and indexes by subscribers has been greatly reduced. This improvement resulted from the installation of new electronic photocomposition equipment at the Government Printing Office (GPO) and from the cooperative efforts of the GPO and the DDC to fully utilize the equipment's productive capabilities.

DDC INFORMATION STORAGE, DISSEMINATION, AND RETRIEVAL



1. Selected documents are converted to microfiche through series of processing steps. Microfiche is placed in document store.

2. Selected documents are processed for entry into computer storage. Such entry is by keyboard from remote data terminal.

Computer stored document data serves as basis for semimonthly index and abstract bulletin. Binary coded data is converted into paper tape format for use by GPO in composing, printing, and distributing index and bulletin to subscribers.

1. Subscriber reviews index and abstract bulletin for literature of interest.

2. Subscriber may order copy of selected literature in either microfiche or hard copy format.

NAME OF SYSTEM:

Medical Record Storage

ORIGINATOR:

Armed Forces Institute of Pathology
6826 16th Street,
Washington, D.C. 20012

OBJECTIVE. To develop a document storage system that will reduce the total space committed to the Institute's voluminous medical history case file and to improve the overall efficiency of the document handling function.

BACKGROUND. The Armed Forces Institute of Pathology is responsible for basic research in all areas of pathology. Over the years it has accumulated a medical history case file containing over one million cases from all parts of the world. New case material is received daily while many onhand cases continue to remain active and to require periodic updating actions. This continuing document file expansion created space problems and reduced search effectiveness. To better insure that the professional staff's document needs are properly met and that individual patient's records can be made simultaneously available to more than one user, a study group recommended adoption of a microfilm jacket method to solve the space and document retrieval problem.

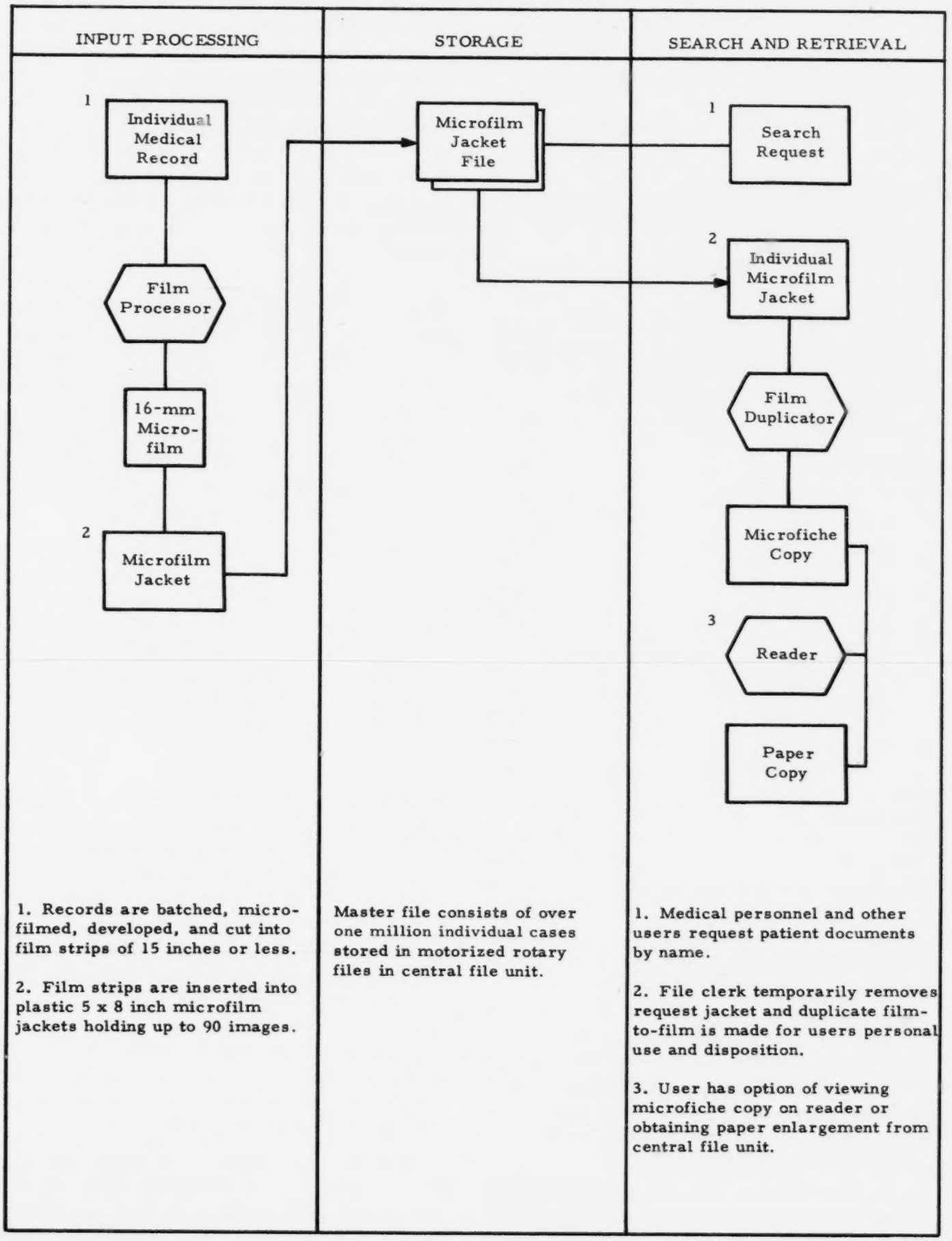
THE NEW METHOD. The first action in converting to the microfilm jacket system consisted of screening the patient medical records, arranging the papers in chronological order, and preparing a log sheet. These medical history documents included such matter as typed reports, charts, graphs, and forms. After other minor actions to insure proper order and control over individual patient records, the documents were microfilmed on a portable, rotary type microfilm camera. After developing, the exposed film was inspected, cut, and inserted into the microfilm jacket slots in a single operation. A special device enables the operator to semi-automatically insert from one to as many as 15 page images in one operation. This insertion technique permits new documents to be added to a patient's jacket record after each period of hospitalization or treatment.

The microfilm jacket used by the Institute is transparent and measures 5 x 8 inches. It is formed by joining two sheets of plastic to provide six rows of horizontal slots for inserting up to 15 image strips of roll microfilm per slot. Each jacket may thus hold up to 90 images with additional jackets established when a patient's record exceeds 90 pages. An opaque stripe is provided on the top of each jacket for showing identifying data in normal size print, and the jackets are maintained in paper folders for ease of withdrawal from the file and for control purposes.

The microfilm jackets are stored in motorized rotary files. When a researcher wishes to retrieve a particular patient's records, the appropriate jacket is temporarily removed from the file, and a duplicate microfiche copy is made for his personal use and disposition. The doctors and other professional people view the filmed images on a microfilm reader located in their individual work areas. The user may position the jacket in the reader through use of control knobs and identification markings. Whenever desired, a paper enlargement of a particular image is made by the central file unit and sent to the user.

REMARKS. The conversion of the former large and bulky conventional document storage system to this miniaturized Medical Record Storage System has resulted in numerous benefits, such as the great reduction in space committed to document storage; the preservation of valuable records and improvement in control over the document files due to the fact that the master film record never leaves the control unit; the relatively easy method of adding new material to the established jacket file; and the capability for making individual patient's records available to more than one user at the same time.

MEDICAL RECORD STORAGE



1. Records are batched, microfilmed, developed, and cut into film strips of 15 inches or less.

2. Film strips are inserted into plastic 5 x 8 inch microfilm jackets holding up to 90 images.

Master file consists of over one million individual cases stored in motorized rotary files in central file unit.

1. Medical personnel and other users request patient documents by name.

2. File clerk temporarily removes request jacket and duplicate film-to-film is made for users personal use and disposition.

3. User has option of viewing microfiche copy on reader or obtaining paper enlargement from central file unit.

NAME OF SYSTEM:

ERIC (Educational Resources Information Center)

ORIGINATOR:

National Center for Educational Research and Development

Office of Education

Department of Health, Education, and Welfare

Washington, D.C. 20202

OBJECTIVE. To make current educational research and related information available promptly and inexpensively to teachers, administrators, researchers, and public officials, and business and industry groups.

BACKGROUND. The overall responsibility of the Office of Education is to collect and disseminate such statistics and facts as shall promote the cause of education within the United States. Within this framework, the Bureau of Research collects and distributes educational research documents to interested educational personnel. To administer this activity, the Office of Education established the Educational Resources Information Center—ERIC. The field of potential information users is broadly based and includes local school districts, colleges, State governments, boards of education, and others involved in educational activities.

THE NEW METHOD. The task of acquiring the significant research material is performed by 20 regional educational information clearing houses that are generally located at universities and regional educational laboratories. All acquired research reports that have catalog listing potential are screened by the clearing houses to insure that all subject matter meets established standards. Selected reports are documented on a special resume or abstract form containing information on specific indexing terms and document identifications.

At Washington, D.C., computer programs permit the monthly field submissions in paper tape format to be quickly machine processed. The resultant product is a computer printout that serves as the basis for the monthly catalog. The contents of the catalog include a list of article titles, the identification numbers, indexes, and a numerical listing of abstract identifications. This comprehensive collection of referenced accessions is then distributed to the many subscribers throughout the country. A copy of any report listed in the catalog may be purchased for a nominal cost from the ERIC Document Reproduction Service, which is operated by a private contractor.

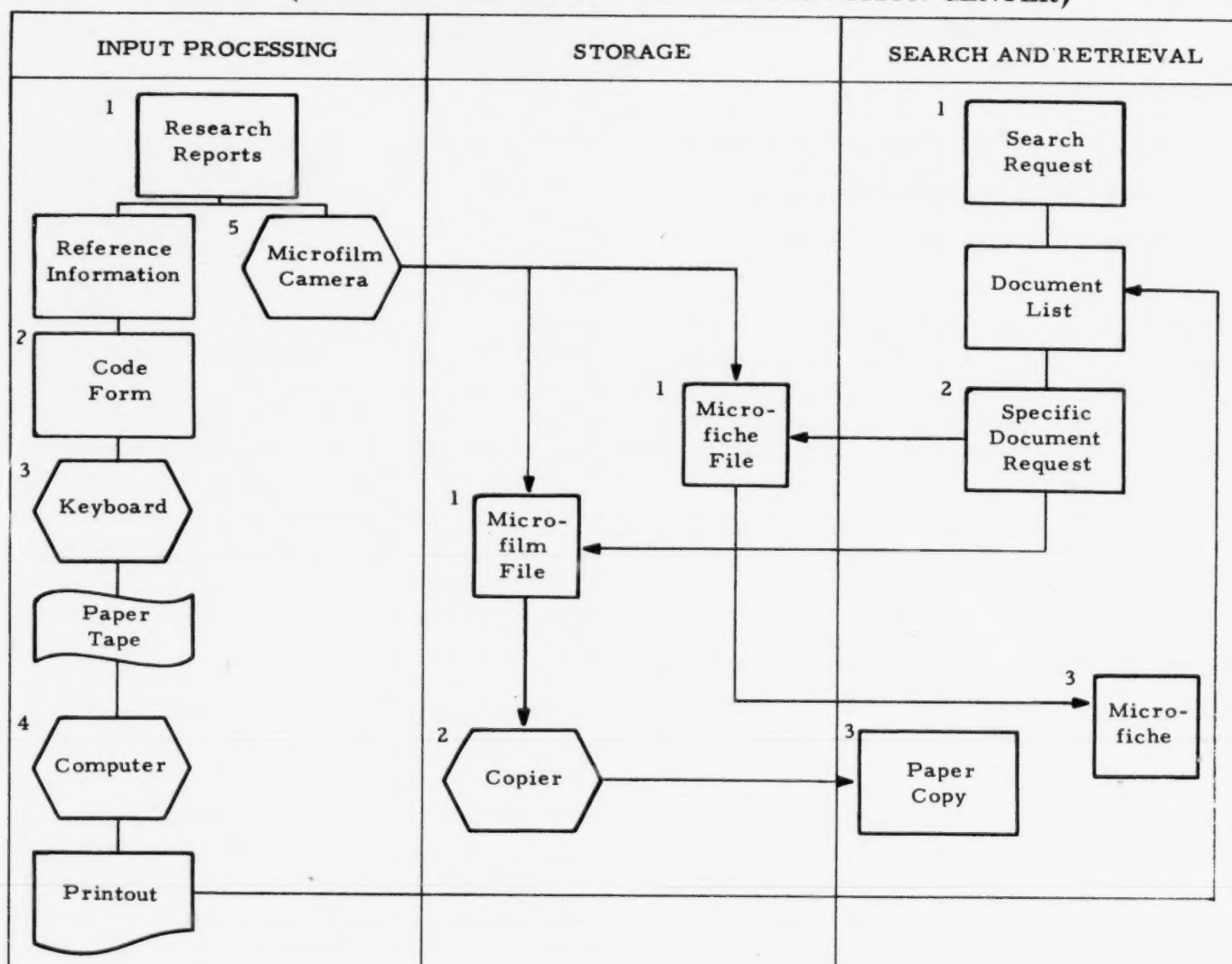
At the contractor facility, the monthly accessions are reduced to the COSATI (Committee on Scientific and Technical Information) microfiche format using a special step and repeat camera. The first 4 x 6 inch microfiche of any individual document may contain up to 60 page images and the second and subsequent microfiche, 72 page images. The form has space reserved at the top for essential identifying data in normal size print.

The subscribing users of the service identify desired research reports by looking through the catalog. Those subscribers wishing to order complete copies of research papers have the choice of two formats: an inexpensive microfiche for those who have access to a microfiche reader or a 6 x 8 inch enlarged paper copy, available at a higher cost.

REMARKS. The ERIC system is a most economical method for storing, retrieving, and disseminating full-page reproductions. This is especially true in instances where the documents to be distributed are already in print when received and where there is a very large user base, since copy reproduction costs are less expensive than other methods. The economy of storage at the user location is also apparent. Further, copies can be readily reproduced on demand by either the central or the user facility, making it unnecessary to maintain any stock. Last, packaging and shipment costs are held to a minimum.

The ERIC program is currently reaching an estimated 477,000 educators each month, and during 1969 about 10 million microfiche were sold by the ERIC Document Reproduction Service.

ERIC (EDUCATIONAL RESOURCES INFORMATION CENTER)



1. Regional clearing houses select and accession proper reports.

2. Clerk converts appropriate information into code form.

3. Operator transforms information into punched paper tape format.

4. Special computer program converts information into printout listing of references.

5. Original reports are forwarded to Bethesda, Maryland and converted into microfilm and microfiche with step and repeat camera.

1. Research information is stored on microfilm and microfiche at the Bethesda, Maryland facility.

2. The facility forwards subscribers information requested in either microfiche or paper copy format.

1. Subscribers search document list for desired articles.

2. Subscribers order items from Bethesda facility by reference number and format.

3. Information is received in desired format.

NAME OF SYSTEM:

Beneficiary Information

ORIGINATOR:

Bureau of District Office Operations
Social Security Administration,
Baltimore, Maryland 21235

OBJECTIVE. To design and place into operation an integrated document retrieval system that will enable the District Offices to provide the public with more accurate, timely, and useful beneficiary information.

BACKGROUND. The Bureau of District Office Operations provides direction to the nationwide network of district and branch offices that serve as the intermediary between the Social Security Administration and the public. Among its many responsibilities is that of providing information to people about beneficiary matters.

For years the district and branch offices administering the Social Security program have had difficulty in responding satisfactorily to the millions of annual inquiries. The growing accumulation of records, together with an increased public awareness about the various entitlements of the programs, has made the answering of questions increasingly difficult. There had been an urgent need for designing a system that would assure that records used in beneficiary interviews were both current and accurate.

Fortunately, during the 1960's the district and branch offices gained much experience in the use of a microfilm retrieval system for handling health insurance inquiries. It was the consensus of those most concerned with the beneficiary information problem that better response to the public would occur only with the design and implementation of a microform system. Accordingly, the decision was made to condense the beneficiary data kept on magnetic tape in Baltimore and to record this data on microfilm. It was further decided that microfiche rather than roll film would be used for the following reasons: the updating is less costly; the shipping problems are less difficult; the look-up time is shorter; the filing sequence is less cumbersome; the reader-printer machine is less expensive.

THE NEW METHOD. The Beneficiary Information System consists of selected information recorded on microfiche. Selected data for 600 accounts is displayed on 4 x 6 inch microfiche cards. (This capacity contrasts with the normal 4 feet of microfilm roll needed for the same number of accounts in the old system.) Each microfiche has 72 frames of beneficiary information arranged into nine columns of eight horizontal rows, with individual frames containing from six to nine accounts. At the top of each microfiche is a header that shows the range of names in normal size print. Additionally, there is an index that shows the x-y coordinate location of records within each frame.

The conversion of the digital input magnetic tape information to the master or orginal fiche format is performed by the Bureau of Data Processing and Accounts. A Stromberg-DatagraphiX 4440 COM (computer output microfilm) recording and developing system is used for this purpose. This special camera records beneficiary data from the magnetic tape on 4-inch wide film at the rate of two to three microfiche per minute, or 1,200 to 1,800 records per minute. The data is reduced on film at a 25 to 1 ratio. The original records are recorded on silver halide roll film, developed as positives, and duplicated on Kalvar negative copies. These copies are then automatically cut into 4 x 6 inch microfiche.

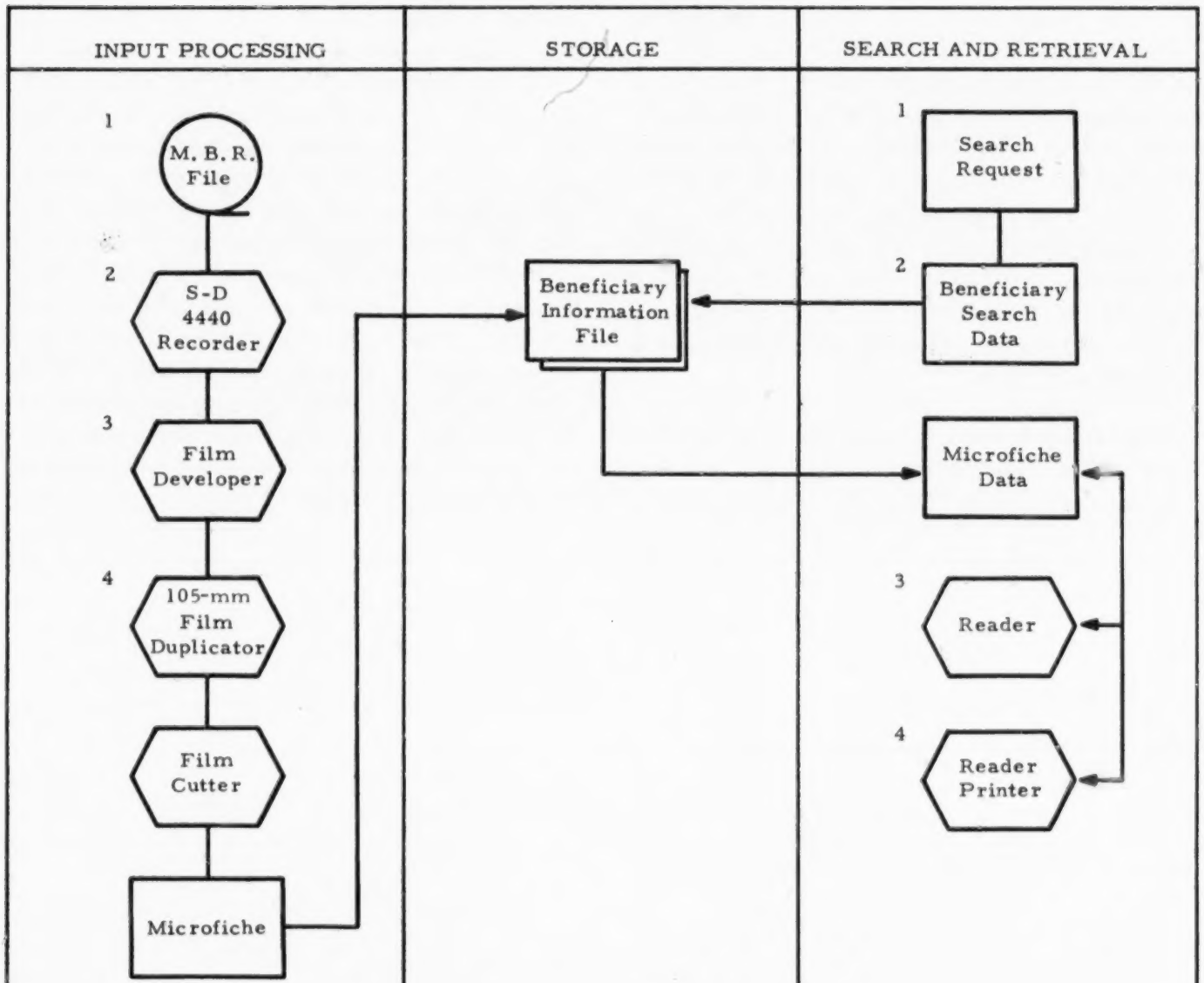
The file is arranged alphabetically by name of the principal beneficiary and contains such information as other beneficiaries, social security numbers, certain historical information, and annual contribution data. The microfiche are filed in an upright metal stand holding a maximum of four or five two-sided panels. Panels are 24 inches high and 18 inches wide, with space for 440 microfiche arranged in three vertical rows. In total, a single panel may contain 264,000 individual records. The microfiche header information is readily identifiable from the file position,

and when a microfiche is removed from the file the background becomes an automatic "charge-out." The microfiche reader contains an x-y grid system corresponding to the grid identification index recorded on each microfiche. With this finding technique, most searches can be completed within 20 seconds.

In the retrieval process, the microfiche file and the reader-printer are usually located in close proximity to the work area of the user-interviewer. Copies of beneficiary records are thus available for viewing or copying in a minimum of time.

REMARKS. This Beneficiary Information System is a classic example of large masses of magnetic tape stored data that is made readily accessible by conversion to a microform format through use of COM equipment. In this instance, the data is made available to 1,000 locations around the Nation. The system utilizes to the fullest the microform characteristics of compactness, convenience of shipment, and economy of storage and retrieval. Additionally, in the case of microfiche, the cost of the semiannual updating of the complete file is quite economical in comparison with other document storage and retrieval methods. The total file of 26 million beneficiary records is contained on about 49,000 silver halide microfiche (originals or masters) at Baltimore. The duplicates forwarded to the nearly 1,000 local Social Security offices number approximately 1.5 million.

BENEFICIARY INFORMATION



1. Bureau of Data Processing and Accounts take selective data from the magnetic tape master beneficiary file for processing and conversion to microfiche.

2. Recorder converts magnetic tape binary code to human-readable print form on 105-mm roll microfilm.

3. Master film is developed as positive and used to develop many negative duplicate sets of uncut microfiche displays.

4. Duplicate negatives are cut into 4" x 6" sheets of microfiche. Complete sets are shipped to local Social Security offices for reference use.

Selective Beneficiary File. Consists of microfiche contained in vertical panel holders (264,000 fiche per panel). Each local social security office has identical system for fast retrieval of information. Fiche are arranged alphabetically with range of names visible on each fiche header.

1. Search request originates with interviewer of beneficiary or intermediary.

2. Searcher, with proper search information, scans file panels for appropriate fiche, using fiche headers as guide.

3. Searcher places fiche in reader and using name index on fiche adjusts reader grid to coincide with coordinate instructions.

4. User has option of retrieving information from reader or making hard copy of record.

NAME OF SYSTEM:

National Employee Account Card Holders

ORIGINATOR:

Division of Accounting Operations

Bureau of Retirement & Survivors Insurance

Social Security Administration,

Baltimore, Maryland 21235

OBJECTIVE. To improve this large document storage and retrieval operation through use of updated methods and equipment in order to greatly reduce total space requirements and provide for improved retrieval techniques.

BACKGROUND. The Social Security Administration administers the Federal retirement, survivors, disability, and health insurance programs as authorized by the Social Security Act. The Division of Accounting Operations supports the overall program by maintaining a "National Employee Index of Account Card Holders." This index contains the names, dates of birth, and social security account numbers of more than 200 million past and present social security registrants. The index is used in the processing of social security applications and requests for social security numbers.

Until 1958, social security card name identifications were contained on individually printed strips mounted on vertical panels holding about 145 names each. The file was arranged by soundex code, which uses a combination of four alpha-numeric characters to represent the individual's last name; that is, the first letter of the last name is followed by three numerical code digits representing the three or less consonant sounds contained in the remaining letters of the name. Identification elements following the soundex code are the full last and first name, middle initial, birth date, and social security number. The magnitude of the file and search operation was astronomical. The millions of name entries required 1.3 million panels, and each year about 50,000 additional panels were needed for new entries.

THE NEW METHOD. The new system is based on use of mechanized roll microfilm. An initial index conversion technique resolved the usual difficulty of efficiently handling the frequent changes made to roll microfilm. The solution consisted of dividing the 100-foot rolls, each having a capacity of 2,000 microfilm image panels, into two segments. The first segment represents about 1,300 film images of the actual flexoline panels used prior to 1958. The second segment, about ⅓ of each roll, consists of cumulative monthly additions and changes. The latter segment of microfilm is discarded each month and an updated, cumulative change segment is spliced onto each reel.

The monthly updating of the current portion of each of the index's 2,005 rolls is made possible through the maintenance of a machine-language data base. Each month the change data is fed into the computer and merged with the latest magnetic tape master file. The conversion into human-readable characters on microfilm is made possible by COM (computer output microfilm) equipment. This equipment also automatically adds an index bar code or code line between images on the film. The rolls of current index information are then cut into segments and used tc replace the outdated portion of each film roll.

The common problem of quick and proper identification of images within each roll of film is solved through use of the bar code or code line image finding technique. In this technique, each frame of microfilm also contains a bar code or code line representing the soundex code of that particular film frame, in addition to the basic index information. The actual position of these bars or lines reflects the soundex code for any given image. Both the pre-1958 segment of the index and the updated segments have bar codes or code lines properly positioned on each film roll.

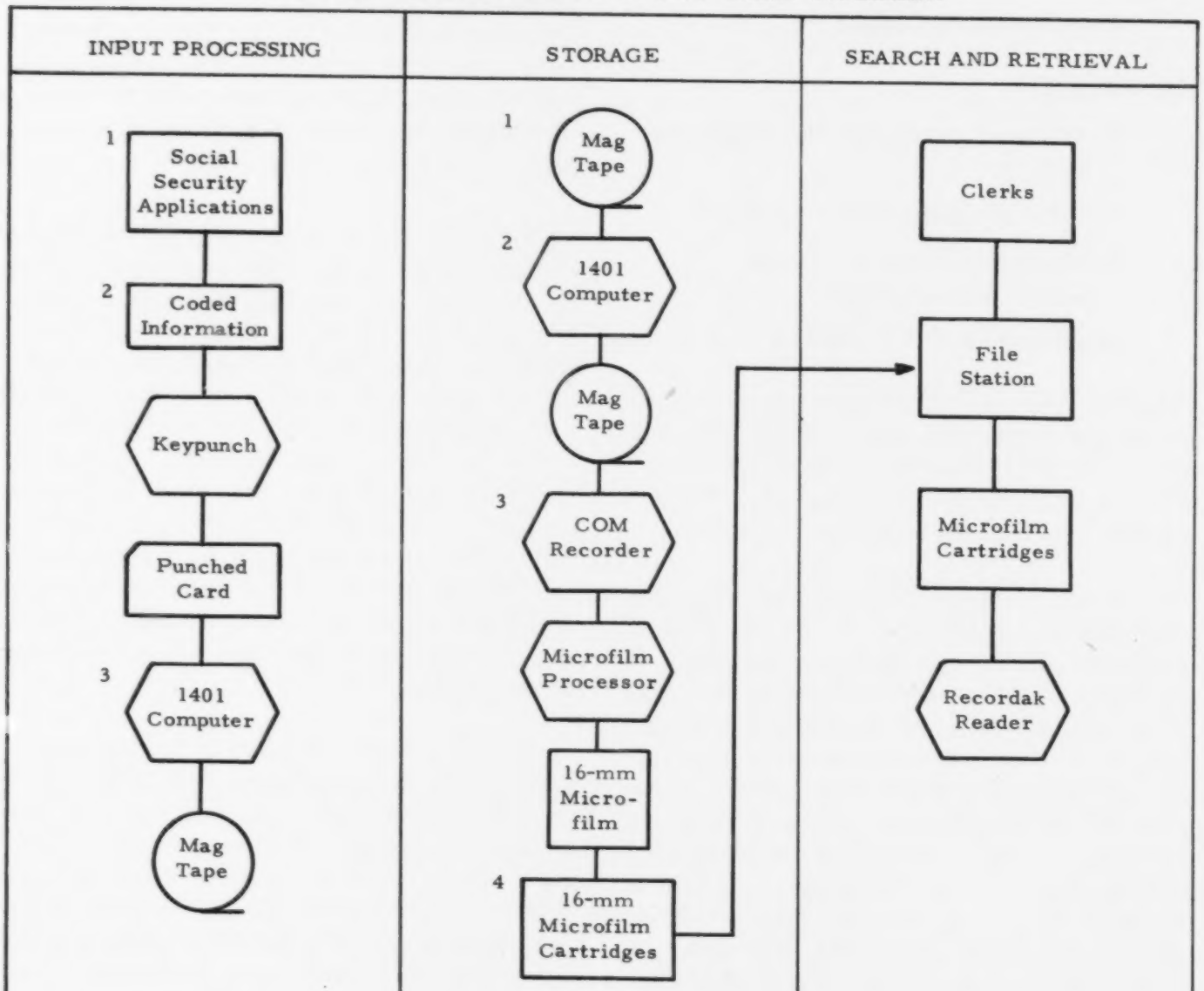
For better operating efficiency, 165 search stations have been established with each sta-

tion assigned an average of 12 rolls housed in cartridges. Each search station also has a mechanized roll microfilm reader using microfilm cartridges. It is electrically driven with varying forward and reverse speeds. The work stations have a processing capability of over 40,000 searches a day.

In an actual search, which usually takes about 30 seconds, the index clerk first selects and inserts the proper cartridge into the reader. The bar code or code line scales on the reader are then adjusted to match the soundex code of the search image. Actuation of the start switch moves film frames past the reader's bar code or code line scale. As the film bar codes shift closer to the microfilm reader's code position the clerk slows film movement so individual frames may be scanned.

REMARKS. In addition to the extensive space savings and ease of updating, this mechanized roll microfilm system also has the advantages of localization of search to 10 images or less; relatively low input costs for the initial conversion to microfilm; fast finding, loading, and unloading of film cartridges; and the option of using any standard roll microfilm reading equipment, since any reader can be adapted to use the bar code or code line image finding technique.

NATIONAL EMPLOYEE ACCOUNT CARD HOLDERS



1. Reflects new social security applications.

2. Clerks and keypunch operators transform information into machine readable language.

3. Computer program converts coded punched card information to magnetic tape.

1. Master file on magnetic tape.

2. Accepts new information on registrants and merges with master file to create new updated master file.

3. Magnetic tape master file converted to photo-optical binary coded microfilm through process of recording, developing, and fixing. Recorder photographs information, adding bar code on 1,000 ft. microfilm rolls.

4. Film is cut into segments and spliced onto film in microfilm cartridges and sent to file station.

Clerks distribute requests to microfilm retrieval work stations. Index clerk places appropriate cartridge in reader and finds proper information through use of film bar codes.

NAME OF SYSTEM:

Automated Personnel

ORIGINATOR:

Automated Personnel Management System

Federal Housing Administration

Department of Housing and Urban Development

Washington, D.C. 20410

OBJECTIVE. To develop a comprehensive integrated personnel data system that will satisfy the Federal Housing Administration's (FHA) various and continuing personnel management and information needs.

BACKGROUND. The Federal Housing Administration carries out broad Federal programs of loan and mortgage insurance as authorized by the Federal Housing Act. The FHA employs about 8,500 personnel throughout the United States in support of these responsibilities. For many years the FHA has been in the forefront of those government activities taking advantage of the capabilities of nonconventional information retrieval methods and techniques to better manage their broad range of affairs. For example, FHA's present Automated Personnel Management System utilizes magnetic tape as the storage medium for their large personnel file.

Illustrative of the growing trend toward shared use of computers, this system exists as a by-product of a completely integrated personnel management application, which in turn shares computer time with several still larger systems in the same computer center. Several of FHA's personnel functional areas benefiting from the storage and retrieval capabilities of this system are the payroll office, personnel placement office, and personnel management activity.

The personnel placement office shall be used to illustrate this system's characteristics in solving information retrieval requirements. This office has information needs of a specific nature due to its interest in evaluating qualifications and eligibility of individuals for promotion or to fill new or vacant positions. To assist in solution of this problem, a magnetic tape skills inventory file contains such helpful information as occupational series, training courses completed, years of service, grade span, and academic fields.

THE NEW METHOD. The initial input of source data to the personnel data master file is the Personnel Transaction Form. Though quite similar to the Standard Form 50, it contains additional information on personnel skills and other data that comprise each employee's profile. Data on the form is coded by a personnel clerk and then converted to punched paper tape on an automatic typewriter. The punched paper tape is forwarded to the computer activity for conversion to punched card format and then batched with other input cards for computer processing and storage on the magnetic tape master personnel file.

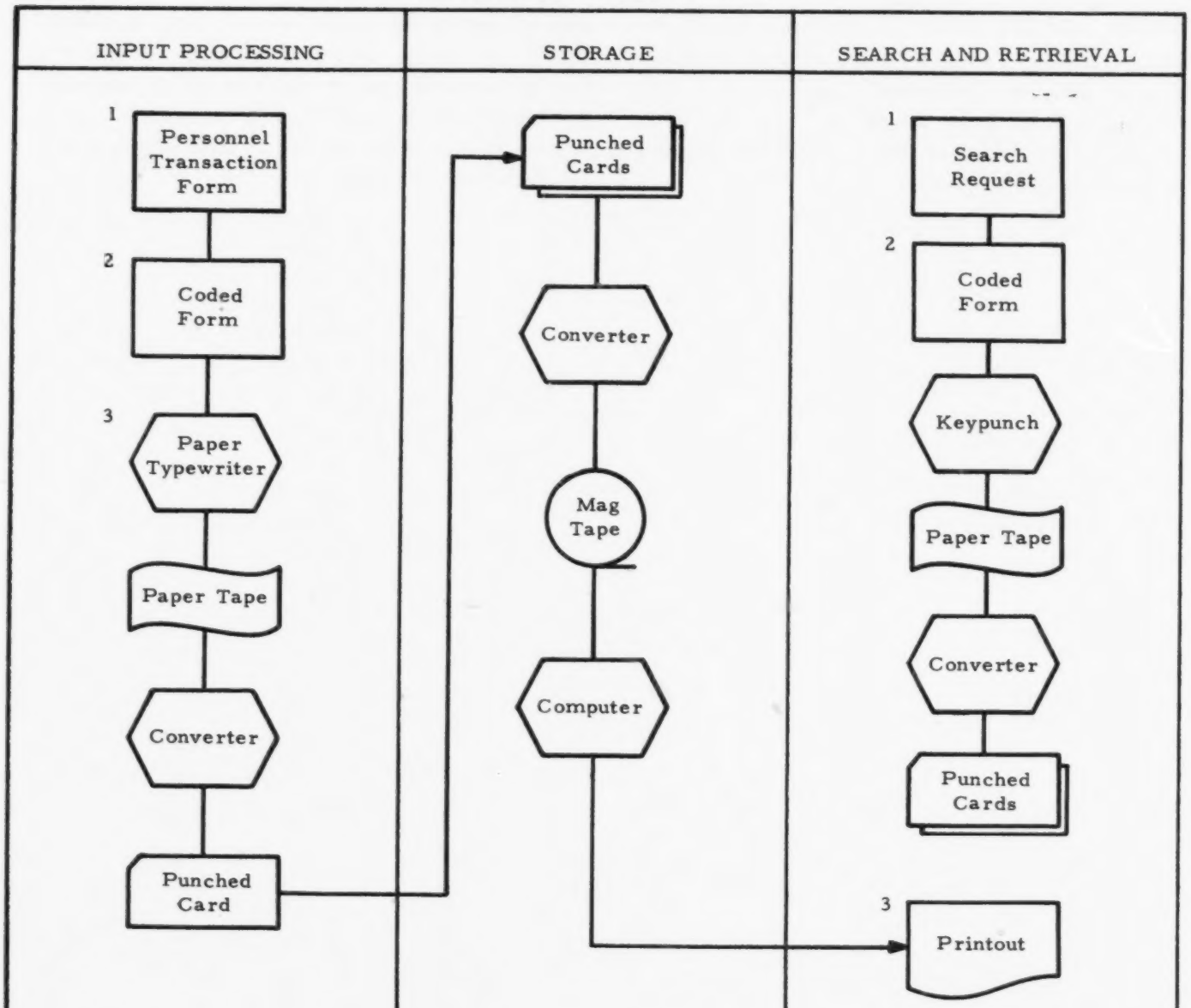
Search requests initiated by managers and supervisors that concern personnel who might be qualified for new or unfilled positions are handled in much the same manner as the initial input to the master file. First, all pertinent skills and other qualifying features of the position are recorded on a skills locator form. This form, which has a potential of 43 different entries, is then reduced to a coded format on punched paper tape for conversion to punched cards. At the computer center, the technicians gather the punched cards for batching prior to their conversion to magnetic tape. After conversion, the skill search tape is programed for matching against the master file tape. The names of individuals found eligible for the position, together with their file folder location identities, are retrieved in the form of a computer printout. A copy of the printout may then be forwarded to the original requesting office for study. Where appropriate, the employee file jacket may be obtained for further study and further action.

REMARKS. The FHA automated personnel system supplies management with impor-

tant information through complex data correlation and improves the overall effectiveness of the personnel system. It produces all regular periodic personnel reports and can analyze information based on specific programing to select the most qualified person for various job vacancies.

This system is a good example of the sharing of computer usage with other organizational elements. Because of the computer's fast processing speed and the FHA system's relatively small workload, a computer could not be justified for use as an information and retrieval system alone.

AUTOMATED PERSONNEL



1. Form is initiated by personnel placement office as a result of information input from individuals.

2. The various skills are coded in the personnel office.

3. A personnel office typist, using a paper tape typewriter, converts the codes to punched paper tape, which in turn is converted into punched cards.

Punched cards are batched, converted to magnetic tape format, and information is added to master tape file.

1. Search request initiated by managers and supervisors through personnel office.

2. Steps follow sequence of input processing steps 2 and 3.

3. The skill search tape is matched against the master tape file. The identities of case folder locations are retrieved in computer printout format.

NAME OF SYSTEM:

Video Tape Information Storage and Retrieval

ORIGINATOR:

Management and Operations Assistance Division

Federal Housing Administration

Department of Housing and Urban Development

Washington, D.C. 20411

OBJECTIVE. To develop an effective automated system for storage and retrieval of case documents essential to the program and administrative functions of the Federal Housing Administration.

BACKGROUND. Since 1934, mortgages on millions of housing structures have been insured by the Federal Housing Administration. The responsibility for the documentation associated with insurance case handling rests mainly with FHA's Management and Operations Assistance Division. Weekly, the Division files about 9,000 new case binders (folders); adds 35,000 pieces of correspondence to in-file case binders; and refiles 3,000 case binders returned by users. The Division also services requests for about 600 case binders daily and retires approximately 250,000 terminated binders annually.

The current file consists of about 4,500,000 cases containing approximately 120,000,000 documents, and it fills 6,500 five-drawer file cabinets occupying 55,000 square feet of floor space. This continuously expanding file gives rise to a mounting number of problems in attempting to provide up-to-date information in an effective manner. After reviewing numerous proposals for graphic storage, retrieval, and presentation systems, the FHA authorities selected the video tape system.

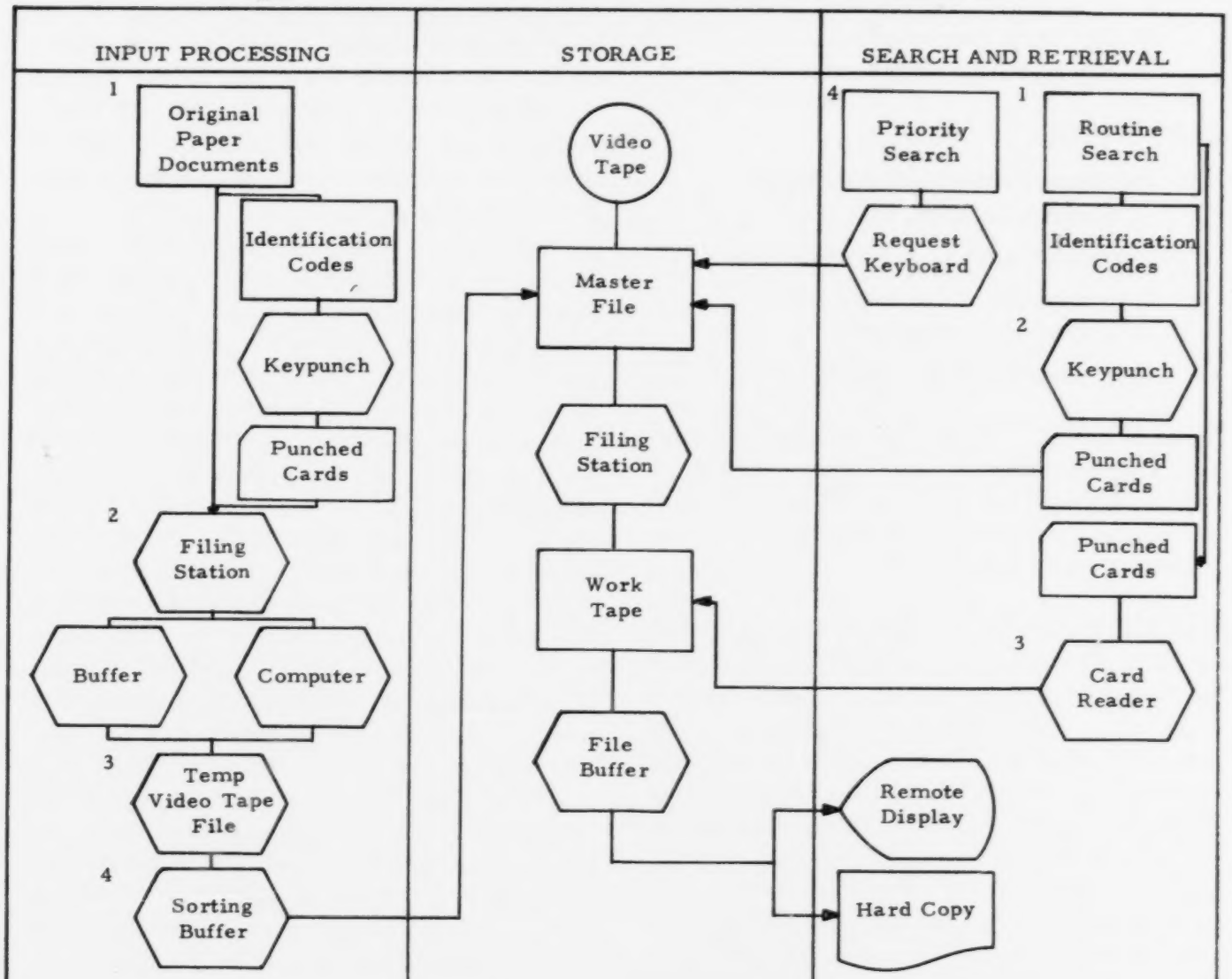
THE NEW METHOD. The FHA Video Tape Information Storage and Retrieval System combines video tape processing with computer technology. Document images are recorded onto video magnetic tape by a television camera mounted in a 75 documents-a-minute automatic filing station. Retrieval of information is accomplished through 21 remote display stations (cathode ray tubes) located in selected FHA offices throughout the HUD Building in Washington. All filing, retrieval, and purge routines are computer controlled and are activated on-line through a teletype keyboard.

For routine requests, users order documents by entering the case number in a punched card. Since the master video tape file is in sequential order by case number, the punched cards are arranged in the same sequence and batched. The cards are processed across the master video tape file at night and the requested document images are transferred to work tapes that are mounted on tape drives for retrieval the next day. The punched cards are returned to the requester, who inserts them into the punched card readers at his remote display station to call up documents to be viewed. When a card is inserted into the reader, the work tape is automatically searched and the document images for that case are electronically transmitted and temporarily copied (stored) on a magnetic disc located in a buffer section connected to the remote station. This makes it possible for the user to leisurely browse back and forth through the document images without tying up the master file. Should hard copy be required, the user may request printouts of selected documents or the entire case file.

REMARKS. The manual files operation, presently located four miles from the HUD Building, will be eliminated when the new system is installed in the departmental building to provide more effective service. The case binder records occupying 55,000 square feet are being converted to an operating system requiring a total of 3,600 square feet. The actual video magnetic tape files will require only about 90 square feet of this space.

The mortgage documentation records will always remain in the file, since document images are copied rather than removed from the master file when needed for viewing. Additionally, the problem of out-of-file documents and the time and expense for manual file maintenance are eliminated under the video tape file system.

VIDEO TAPE INFORMATION STORAGE AND RETRIEVAL



1. Document descriptive data converted to digital address on punched cards.

2. Document and pertinent punched card descriptive data loaded into automatic filing station. The graphic images and associated index data is simultaeously recorded on video tape at rate of 75 documents per minute.

3. Recorded data in electronic image form is temporarily held in intermediate storage pending entry into master file.

4. Daily accumulation of data is sorted into document case sequence for merging with master file.

Master video tape file consists of over 4.5 million mortgage case files organized in case number sequence. Each tape reel holds 127,000 document images when full.

1. Routine searches are initiated through use of punched cards showing case number desired.

2. Daily searches are batched and processed against master file with pertinent document images transferred to a working video tape file.

3. Retrieval of data at remote search stations is actuated by placement of punched card in card reader. Proper case image is displayed on CRT remote monitor. Searcher may obtain hard copy facsimile of image if desired.

4. Priority searches are initiated at remote terminals through request keyboard directly to master file. Retrieval options are as noted in item 3 above.

NAME OF SYSTEM:

Land Patent Control Document Index

ORIGINATOR:

Bureau of Land Management

Department of the Interior

Washington, D.C. 20240

OBJECTIVE. To develop and implement an information handling system that will help preserve old historical patent documents and improve the management of public land records.

BACKGROUND. The Bureau of Land Management (BLM) is responsible for the conservation and management of public domain lands and resources of the Nation. The forerunner of the present Bureau, the General Land Office, was established in 1812 to "keep land records and record titles." Today, the Bureau of Land Management is responsible for all the control documents, which include patents, lists, and other instruments that convey title. These control documents pertain to the one-half billion acres of present public domain land and the more than one billion acres, representing seven million ownership titles, granted since the first public land patent in 1788.

The methods of keeping these public land records had changed little through the years until it became almost impossible to handle some of the older, active records. The Bureau of Land Management solved the problem by turning to microfilm as the best medium for preserving the old records as well as for day-to-day search and retrieval activities.

THE NEW METHOD. Beginning in 1955 and lasting for one year, all the old records legible enough for processing were recorded on 35-mm. microfilm. Subsequently microfilm positive images were made from the master file and mounted on aperture cards. More than four million such cards were produced. Later, the aperture cards were keypunched, sorted by land description, and duplicated. One copy was shipped to the appropriate State land office to satisfy local management needs and the other remained with the BLM in Washington, D.C.

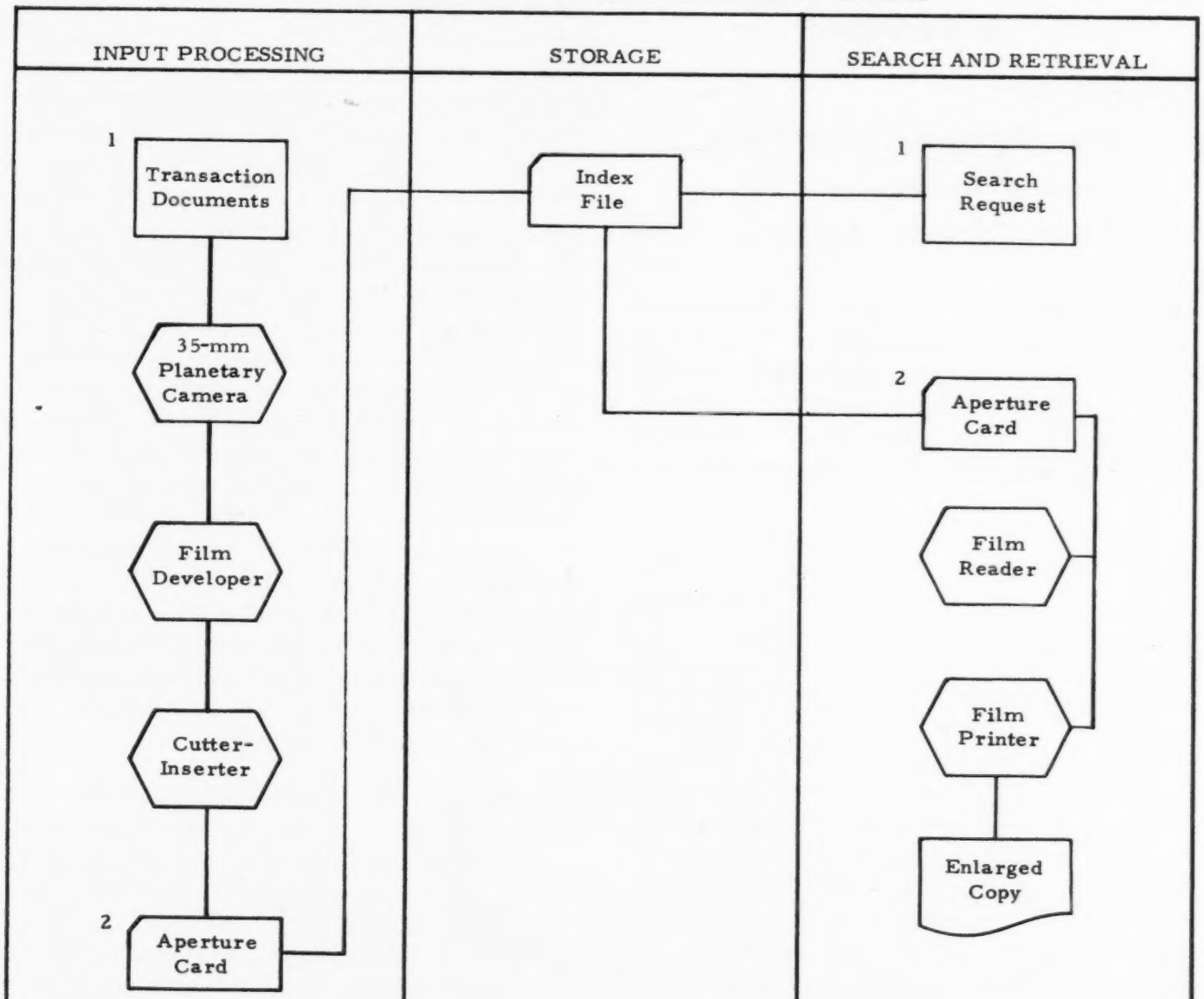
Under present procedures, newly created control documents originating in the 12 regional offices are forwarded to the Bureau of Land Management in Washington. Documents, usually consisting of one to four pages, appear in many formats and pertain to orders, acts, and proclamations regarding rights and uses of land. Each record is recorded on 35-mm. roll microfilm, which is cut into individual images and mounted on military size D aperture cards. The identifying index information is then typed across the top of each card. Two such aperture cards are made for each control document. One is forwarded to the security file and the other sent to the originating State's public use file. Files are arranged geographically by State, meridian, and township. Within the township file, they are filed chronologically by the effective date of issue.

The users of the files include the general public, such Government agencies as the Department of Defense and the General Services Administration, and many State agencies. Individuals tracing the chain of land patent transfers request the land patent by meridian and township. Since location of the patent search is usually known, the search clerk can normally retrieve the proper aperture card in a minimum of time, on the basis of the printed heading. The searcher may either obtain an enlarged copy of the patent made from the aperture card or visually review the patent information on an aperture card viewer, which is usually located in the State's BLM public reference room.

REMARKS. The main advantage of the aperture card as a storage media for large and cumbersome documents is its small uniform size, which reduces the total storage space and facilitates document handling. The file's relatively small size makes it possible to store the documents close by the user's work area and permits fast retrieval. In addition,

the new system assures that these valuable records will be spared further wear and tear and that they will be protected against accidental loss or destruction. Further, there is available a wide variety of relatively low-cost equipment for viewing, duplicating, and making paper enlargements of the images. Finally, the cards can be keypunched, if desired, to permit machine sorting, merging, and searching.

LAND PATENT CONTROL DOCUMENT INDEX



1. Land transaction documents are forwarded to Washington, D. C. for film processing. Two sets of aperture cards are produced through a series of processing steps. Index information is manually placed across the top of each card.

2. A working aperture card is returned to the State office of origin and the other copy is placed in the security file at Washington, D. C.

Central document index files are maintained at each State office. Current size of the collection numbers over 10 million documents.

1. Searches are initiated by private individuals and Government officials. Index file is searched manually by township identification.

2. Retrieved information may be in the form of an enlarged printout or as an image on the film reader.

NAME OF SYSTEM:

SDI Current Awareness

ORIGINATOR:

Office of Engineering Reference
Bureau of Reclamation
Denver, Colorado 80225

OBJECTIVE. To design and establish a system for selective dissemination of information (SDI) to members of the Bureau's Engineering and Research Center in order to increase the staff's opportunity for obtaining significant literature on subjects of interest.

BACKGROUND. The Bureau of Reclamation is responsible for planning, designing, constructing, operating, and maintaining multipurpose water resources projects in the Western United States. A vital element in the success of these efforts is the Engineering and Research Center at Denver, Colo. Its Office of Engineering is responsible for keeping abreast of the technical literature in the broad field of water resource investigation. Among the office's many functions is that of developing improved methods for alerting the staff and field personnel to meaningful literature. To better satisfy this objective, the Office of Engineering Reference several years ago established an SDI system for staff and field engineers, specialists, and management personnel.

THE NEW METHOD. This system evolves around the matching of an individual's fields of interest descriptors (indexing terms) with descriptors that have been assigned to individual documents acquired by the Office of Engineering Reference.

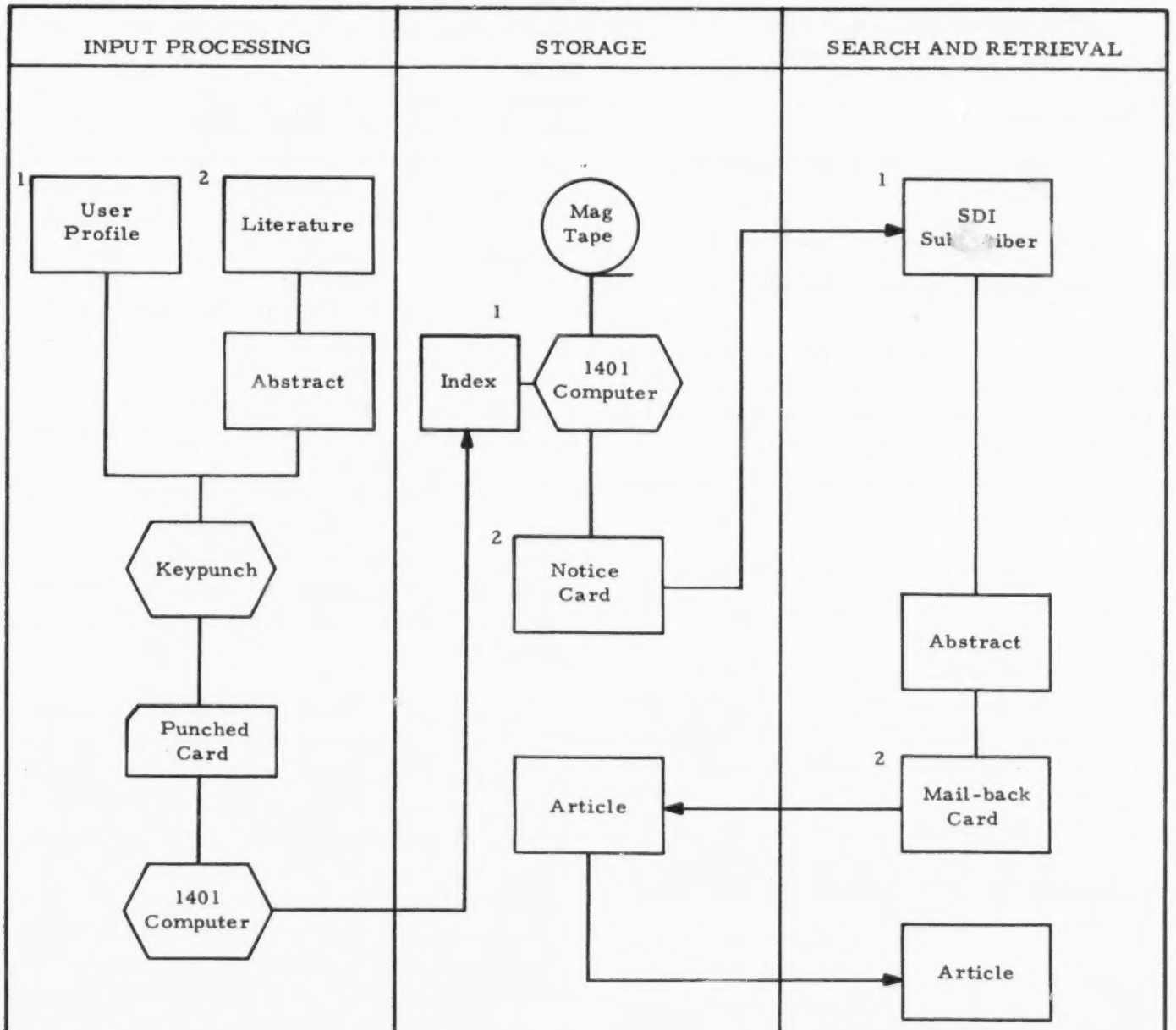
Each document selected for possible inclusion in the SDI system is first scanned by an engineer or scientist whose job assignment concerns that specific subject matter area. Professional library personnel index the articles in depth, abstract the essential information, and compile the necessary bibliographic data. The information is then converted to magnetic tape format for entry into the computer's SDI matching program.

A thesaurus wordlist specially developed for this purpose is used for indexing both the employee interest profiles (subject areas of interest to them) and the documents. The list contains about 3,300 descriptors representing the Bureau's point of view on all aspects of water resources development. When a new document is entered into the system, the Bureau's computer compares the list of descriptors describing individual user interests with those assigned the document. As matches occur, the computer prepares lists of individuals who are likely to be interested in the selected document. Abstracts of the documents are then automatically disseminated to them. A response card is enclosed with the abstract for completion by the recipient as to the accuracy of the match. This feedback of information allows for appropriate adjustments that are intended to improve the user's profile selections by eliminating literature of little interest. In filling out this response card the recipient also indicates how useful the information was and whether he wants the complete document.

REMARKS. Through feedback of the recipient's response cards, the effectiveness of the SDI system can be constantly evaluated. Where the response cards indicate that the information is pertinent, it is clear that the matching profiles seem to function satisfactorily. Where they indicate that the information should be more pertinent, the system may need to be improved or expanded. As changes occur in a recipient's interests, feedback to the system causes his profile card to be updated. Thus, the users are reasonably assured that documents relating to their job assignments will be brought to their attention, and they, at the same time, are relieved of the time-consuming, tedious chore of having to personally assemble and scan the enormous volume of documents being produced today.

The computer program includes a program technique that gives relative weight to both user profile and document abstract descriptors. This feature tends to eliminate less relevant matches and assures a more meaningful selection of abstracts. The document index file can also be used in the normal manner for conducting retrospective searches upon request of the users.

SDI CURRENT AWARENESS



1. Subscriber profiles are processed for entry into computer storage.

2. Selected literature is abstracted and processed for entry into computer storage.

1. Profiles of over 700 personnel of the Bureau of Reclamation are stored in the computer memory.

2. Abstract descriptors are matched against user profiles for identity of interested users. Weekly print program produces profile and document matches.

1. Subscriber receives mail-out notice card with abstract of matched information.

2. Mail-back portion of SDI notice card is used to request a copy of article or to have profile changed.

NAME OF SYSTEM:

Information Retrieval and SDI Current Awareness

ORIGINATOR:

Bonneville Power Administration (BPA)

U.S. Department of the Interior

Portland, Oregon 97208

OBJECTIVE. To establish a system for selective dissemination of information (SDI) that will better assure that new electrical engineering information is promptly brought to the attention of the engineering and technical personnel assigned to the BPA.

BACKGROUND. The Bonneville Power Administration is an agency of the U.S. Department of the Interior and is responsible for the marketing of power produced by Federal multipurpose dams in the Columbia River Basin system. This complex represents the largest hydroelectric development of any single river basin in the world. In fulfilling the mission, the Administration employs 600 engineers, the majority of whom are interested in electrical engineering and related subjects.

The growth rate of scientific knowledge and the parallel increase in professional literature has made it increasingly difficult for engineers and scientists to keep abreast of new developments in their fields of interest. They often have no choice but to read material because it may seem to contain substantive matter, only to find it is meaningless. Conversely, because of the sheer mass of new literature, many items of professional value may be overlooked.

Because of the need for its staff to keep abreast of these new technological developments, the BPA established a computer-based system for periodic, selective dissemination of information.

THE NEW METHOD. This SDI system is based on a BPA modification of a System 1401 computer program developed by the International Business Machines Corporation. In broad terms, the system establishes and maintains a list of 400 BPA members desiring to obtain periodic notification of abstracts of specific literature. Each subscriber has at least one interest profile (subject areas of interest to him) recorded on the magnetic tape file. The average range of profiles per participant is six to 10.

Each week the BPA library selects about 125 abstracts from American and foreign professional literature in the field of power transmission. Screening of literature is performed by a professional engineer on the library staff. The abstracts either accompany the literature or are obtained from abstracting services. The selected abstracts are converted to punched cards for processing. The input cards are coded to show information covering author, title, source, summary, and comments.

The indexing of individual items within the context of SDI consists of assigning descriptors (indexing terms) and phrases to the abstract so that it can be used for matching against the users interest profiles in the subsequent processing action. An automatic indexing system is primarily used for this purpose. Descriptors are lifted directly from the terminology appearing in the text of the abstract and, based on a matching program, are appended in alphabetical order to the abstract record.

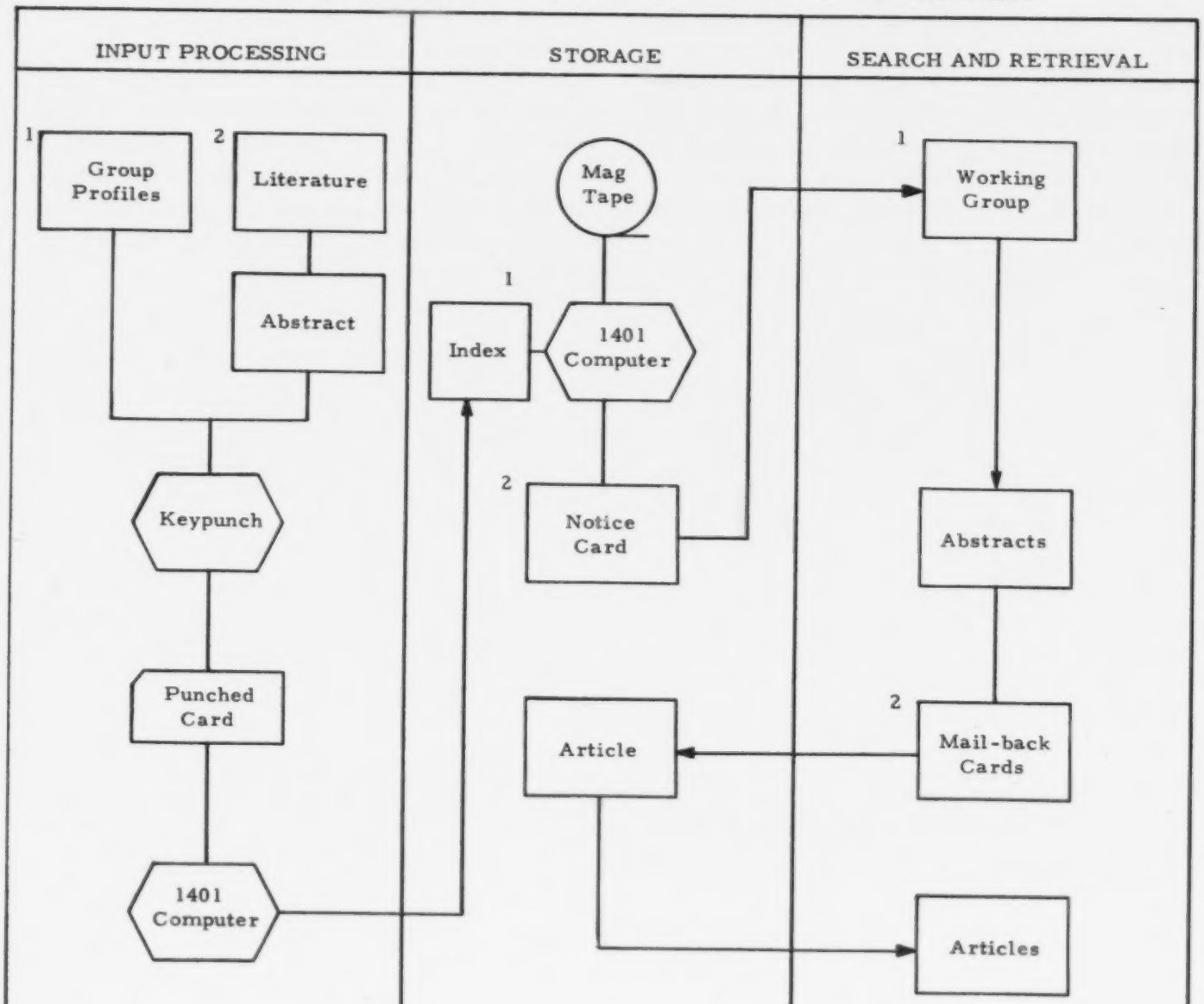
Weekly computer runs match the abstract indexes against user profiles to produce a printed abstract card notice alerting a subscriber to literature of interest. Should he then desire a copy of the actual document, he need only detach an accompanying self-addressed notification card and forward it to the library.

REMARKS. Perhaps the outstanding feature of this pioneering Selective Dissemination of Information System is its flexibility, which includes its ability to serve both current awareness and retrospective search functions.

For retrospective search, the abstracts are retained on a cumulative magnetic tape file and processed against special inquiries as needed. When the file approaches unreasonable limits, a special program purges the abstracts appearing to have the least retention value. About 1,400 output notices are printed per week for the current awareness processing.

Engineers enrolled in the Bonneville SDI system have expressed satisfaction with its ability to disseminate a higher proportion of meaningful information. Evaluation cards completed by subscribers reveal that 57 percent have a direct interest in information received. Of particular interest, only 4.5 percent of those having a direct interest had seen the subject matter before being alerted by the SDI system.

INFORMATION RETRIEVAL AND SDI CURRENT AWARENESS



1. Subscriber profiles are processed for entry into computer storage.

2. Selected literature is abstracted and processed for entry into computer storage.

1. Profiles of over 400 Bonneville power administration personnel are stored in computer memory.

2. Profiles are contained in 70 groups of interests. Abstracts are matched against group interests to identify personnel to receive abstract notices. Weekly print program produces identities of matching groups.

1. Working groups receive mail-out notice cards and extracts for members of group with matched profiles.

2. Mail-back portion of card is filled out by individuals within group to obtain copy of article or to change profile descriptors.

NAME OF SYSTEM:

RIRA Legal Information

ORIGINATOR:

Reports and Information Retrieval Activity

Office of the Chief Counsel

U.S. Internal Revenue Service (IRS),

Washington, D.C. 20224

OBJECTIVE. To develop and operate a document reference system that will provide for more comprehensive and timely information by which legal and management personnel can make their decisions, thus assuring a more consistent treatment and handling of taxpayer matters and the many IRS tax cases.

BACKGROUND. The Office of the Chief Counsel, IRS, is responsible for adjudicating over 28,000 income tax cases annually. This workload is divided among hundreds of attorneys assigned to Washington and the many field offices. Two problems of continuing concern have been those of "network" coordination of pending legal cases and difficulty in maintaining legal consistency in tax cases of a similar nature.

An IRS study group found that better communication and coordination between Washington and the field offices should alleviate the condition. The study group recommended that a uniform subject classification system be established throughout the network.

THE NEW METHOD. The heart of the RIRA (Reports and Information Activity) legal information system is the Uniform Issue List, issued in two distinct formats. The first and more stable basic list is keyed directly to the Internal Revenue Code and arranged sequentially by an eight digit code numbering system. In appearance, the format arrangement is not unlike the hierarchical subject classification outlines appearing in conventional filing manuals. The Uniform Issue List covers over 6,000 subjects and is listed on 85 printed pages.

The companion handbook incorporates the permuted index technique and is known as the KWIC (*K*ey *W*ord *I*n *C*ontext) Index to the Uniform Issue List. The KWIC Index is a computer prepared and maintained reference index. The major task in preparing this index was the conversion of all subject topics and code symbols contained in the basic Uniform Issue List to machine language. With the aid of computer programs, the machine output was in the appropriate KWIC Index format.

In appearance, the KWIC format is an arrangement of two columns of information. The first column near the center contains a permuted alphabetic listing of all pertinent words included in the subject topics of the Uniform Issue List together with the words immediately before and after the key word. The second column, at the far right, indicates the eight digit code symbol of the Uniform Issue List entry applying to the particular permuted term. In essence, the KWIC Index serves as an alphabetic cross reference index to the Uniform Issue List and the individual tax case files.

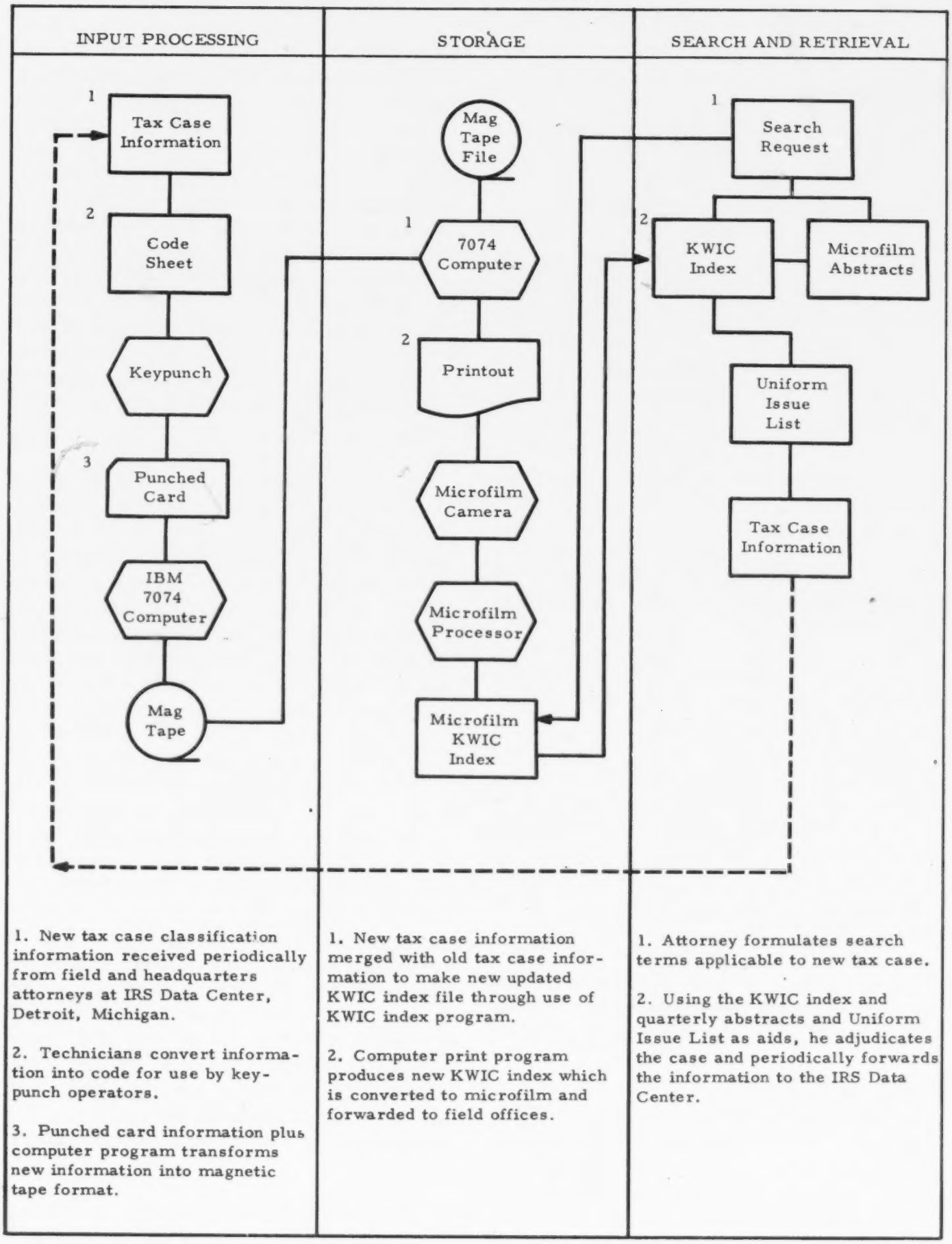
The key sources of information input to the KWIC Index are the monthly submissions forwarded by the field attorneys to the IRS Data Center in Detroit. These reports show the classification codes assigned new cases during the reporting period and also include abstracts covering the essential features of each case. The central computer then consolidates these hundreds of cases in Uniform Issue List and KWIC Index order. These listings, along with the abstracts, are microfilmed, and copies are sent to the field offices to provide the legal staffs a simple low-cost reference tool for use in carrying out their work. The same aids are also used by attorneys and management officials in the main office.

REMARKS. The computer produced permuted or KWIC Index of four or five word entries is a most efficient method of finding references in depth, especially where conditions dictate a large base of subject entries. Manual methods of establishing and main-

taining this type information in accumulative fashion are usually impractical, except when the total entries are in the hundreds; and even then, manual methods are not as comprehensive as a KWIC Index.

With many standard off-the-shelf computer programs available for preparing a KWIC Index, the total cost of such indexes has been substantially reduced. Additionally, the computer printout may serve as the final copy for offset printing of the index. KWIC Indexes may be produced and revised periodically, often at a nominal cost, for use at many locations, as in this example.

RIRA LEGAL INFORMATION



1. New tax case classification information received periodically from field and headquarters attorneys at IRS Data Center, Detroit, Michigan.

2. Technicians convert information into code for use by keypunch operators.

3. Punched card information plus computer program transforms new information into magnetic tape format.

1. New tax case information merged with old tax case information to make new updated KWIC index file through use of KWIC index program.

2. Computer print program produces new KWIC index which is converted to microfilm and forwarded to field offices.

1. Attorney formulates search terms applicable to new tax case.

2. Using the KWIC index and quarterly abstracts and Uniform Issue List as aids, he adjudicates the case and periodically forwards the information to the IRS Data Center.

NAME OF SYSTEM:

National Crime Information Center (NCIC)

ORIGINATOR:

Federal Bureau of Investigation

Department of Justice

Washington, D.C. 20530

OBJECTIVE. Through utilization of the latest computer and communication technologies, to design and operate a centralized information and retrieval system that will greatly improve the effectiveness of crime prevention and detection procedures throughout the country.

BACKGROUND. The idea of a centralized crime information facility was conceived as a result of law enforcement's growing need for faster receipt of crime information, made imperative by the steadily rising incidence of crime and the increased mobility of criminals.

Advances in computer and communication technologies seemed to offer new solutions to these needs. Therefore, the FBI, in conjunction with the Advisory Group to the Committee on Uniform Crime Records, and other local, State and Federal agencies, agreed to exploit these new technologies in their crime fighting efforts. Thus, a series of policy and procedure meetings were held to formulate a program, which led to the establishment of the National Crime Information Center (NCIC). The information center began operations in January 1967. Since that time, due primarily to the support from local police, the system has expanded at a rate far exceeding original expectations.

THE NEW METHOD. The new system, located at the FBI Headquarters in Washington, D.C., is designed for the rapid interchange of information among law enforcement agencies, including most States, the District of Columbia, and Canada. The NCIC is an on-line, real-time information retrieval system.

Connecting terminals, placed near radio dispatchers, are located throughout the country in police headquarters, sheriffs' offices, State police facilities, and Federal law enforcement agencies. Dispatchers can respond quickly to requests from policemen on the street—an inquiry can usually be answered in less than a minute following the inquiry, if the proper procedure is followed. Presently, about 93 terminals are connected to the information system. This includes pertinent incoming data for storage in the file, in addition to inquiries relating to search requests. The base data stored in the computer memory contains data on such matters as wanted persons; stolen and wanted vehicles and license plates; stolen articles; missing or recovered guns; and stolen or missing stocks, bonds, currency, etc.

All items in the above categories are given identifying numbers for searching purposes. The system presently contains 1.8 million records, with an average daily transaction load of 55,000. This volume reflects updating of old records, the entering of new records, and processing of inquiries on suspected crimes or criminals. The system is now averaging 525 positive responses daily to law enforcement officials. These informative responses from the NCIC are considered as guidance only, and investigations are not terminated until confirmation is made with the originating agency. Cooperating agencies are responsible for maintaining the accuracy of their records, updating them when necessary, and purging the records no longer needed.

To illustrate how the system works, let us assume that a State trooper notices an abandoned car. He radios the pertinent data to his radio control dispatcher, who passes the information by informal note to a remote terminal or teletype operator. At that point, the operator arranges the information in properly coded transmission sequence for communicating with the NCIC in Washington.

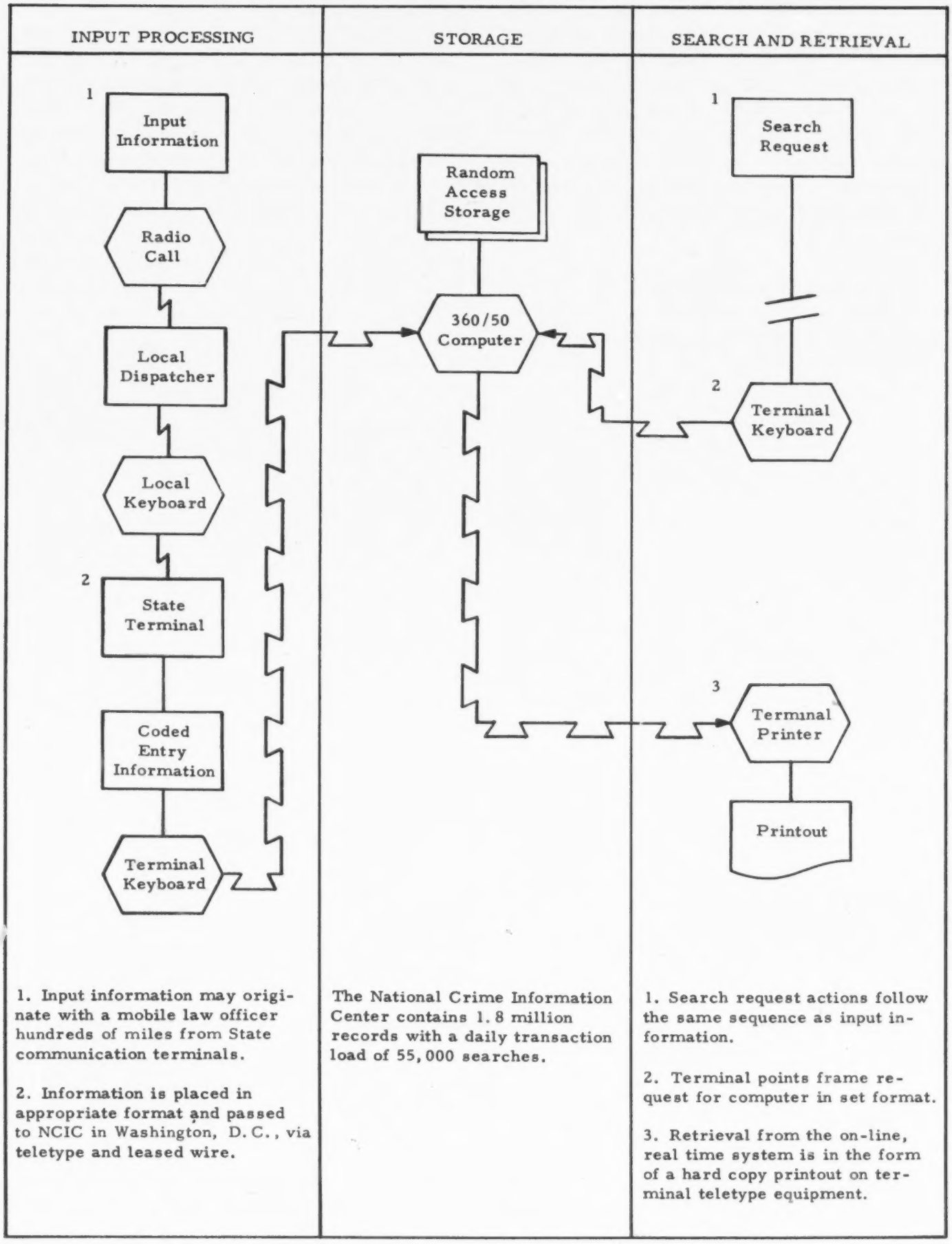
The entry procedure includes identifying the station originating the request, the subject file to be interrogated, and last, the coded

brief of the search request. At NCIC headquarters the IBM 360 Model 50 computer, with the aid of a sophisticated program, searches its random-access storage unit and—in this example—finds a "match" identifying the abandoned vehicle as one that was reported stolen. Within minutes, the NCIC terminal keyboard operator teletypes the answer to the requesting police agency, which then arranges to have the car returned to its owner.

Information intended as input for the system's data bank storage unit is handled in much the same way as a search request.

REMARKS. This system is a good example of how computer and communication capabilities have been utilized to meet a growing information problem. The computer's ability to quickly store, retrieve, and manipulate large quantities of randomly filed data, coupled with the capability for fast transmission of information over great distances, has enabled law enforcement officers at remote locations to communicate with the NCIC almost instantaneously. These machine capabilities and the close cooperation of the local, State, and FBI law enforcement bodies will play an increasingly important role in the battle against crime.

NATIONAL CRIME INFORMATION CENTER



1. Input information may originate with a mobile law officer hundreds of miles from State communication terminals.

2. Information is placed in appropriate format and passed to NCIC in Washington, D.C., via teletype and leased wire.

The National Crime Information Center contains 1.8 million records with a daily transaction load of 55,000 searches.

1. Search request actions follow the same sequence as input information.

2. Terminal points frame request for computer in set format.

3. Retrieval from the on-line, real time system is in the form of a hard copy printout on terminal teletype equipment.

NAME OF SYSTEM:

Congressional Information Network

ORIGINATOR:

Legislative Reference Service
Library of Congress
Washington, D.C. 20540

OBJECTIVE. To develop and operate a document storage and dissemination system capable of providing the members of Congress with current information as to the status of legislation, committee hearings, the budget, and other significant matters.

BACKGROUND. The United States Congress, as it enters the decade of the 1970's, is faced with legislative demands of extraordinary complexity. Each congressional member must function effectively in his several distinctive roles of office. These activities include that of legislator, rendering decisions of national and often world-wide importance; of prime representative of his State or district; and of helper to constituents having specific problems or complaints. The ability of the Congressmen and their committees to effectively discharge their duties is often hindered by the great number of routine tasks to be performed, the great variety of information to be acquired, and the diverse issues to be evaluated.

The stresses upon the members and their staffs have been augmented by the effects of the information explosion. The profusion of books, articles, analytical reports, and miscellany threatens to overwhelm the present information handling centers. Traditional procedures for acquiring, indexing, abstracting, storing, processing, retrieving, and disseminating urgent information do not effectively meet present demands. Thus, the Congressman must evaluate new methods, techniques, and tools to assist him in the performance of his legislative and administrative tasks. Steady advances in information handling technology over the past 20 years now demonstrate the proven potential of technology to better support the Congress in a number of application areas.

The following example is but a beginning in a series of automated information processing programs aimed at enhancing the chamber, committee, and individual member performance.

THE NEW METHOD. The Library of Congress, Legislative Reference Service (LRS), is now providing more responsive support to Congressional members and committees in the information sciences. The first application of the system for the Congress was the "Digest of Public General Bills," which summarizes the essential features of all public bills and resolutions. Essential identifying information on each piece of legislation includes the name of sponsor(s), the date introduced, the bill number, and the committee to which assigned, plus synoptic and indexing information. This information is placed in the disk storage unit of an IBM 360, Model 40 computer through use of a remote ATS (administrative terminal system) text processing system. Six IBM Model 2741 remote terminal selectric typewriters are used for insertion, recall, and editing of the "Bill Digest" information. The Digest is produced cumulatively every two months, with supplements produced every two weeks. Each of these publications is printed by photo-offset methods by the Government Printing Office (GPO).

Each month a "Legislative Status Report" encompassing digests and status information on 200 to 300 major bills is produced, using the same ATS remote terminal and storage system. The 11 by 15 inch computer output continuous paper form is reduced to an 8½ by 11 inch master copy through use of a Xerox 2400 Mark IV duplicator. The necessary copies for distribution to the Congress and other interested agencies and individuals are produced by a Multilith duplicator. The ability of the computer to add data elements without regard to sequence and to rapidly change obsolete material have proven to be particularly useful in this application.

The Congressional Information Network is also used for producing and disseminating the periodic "Congressional Committee Cal-

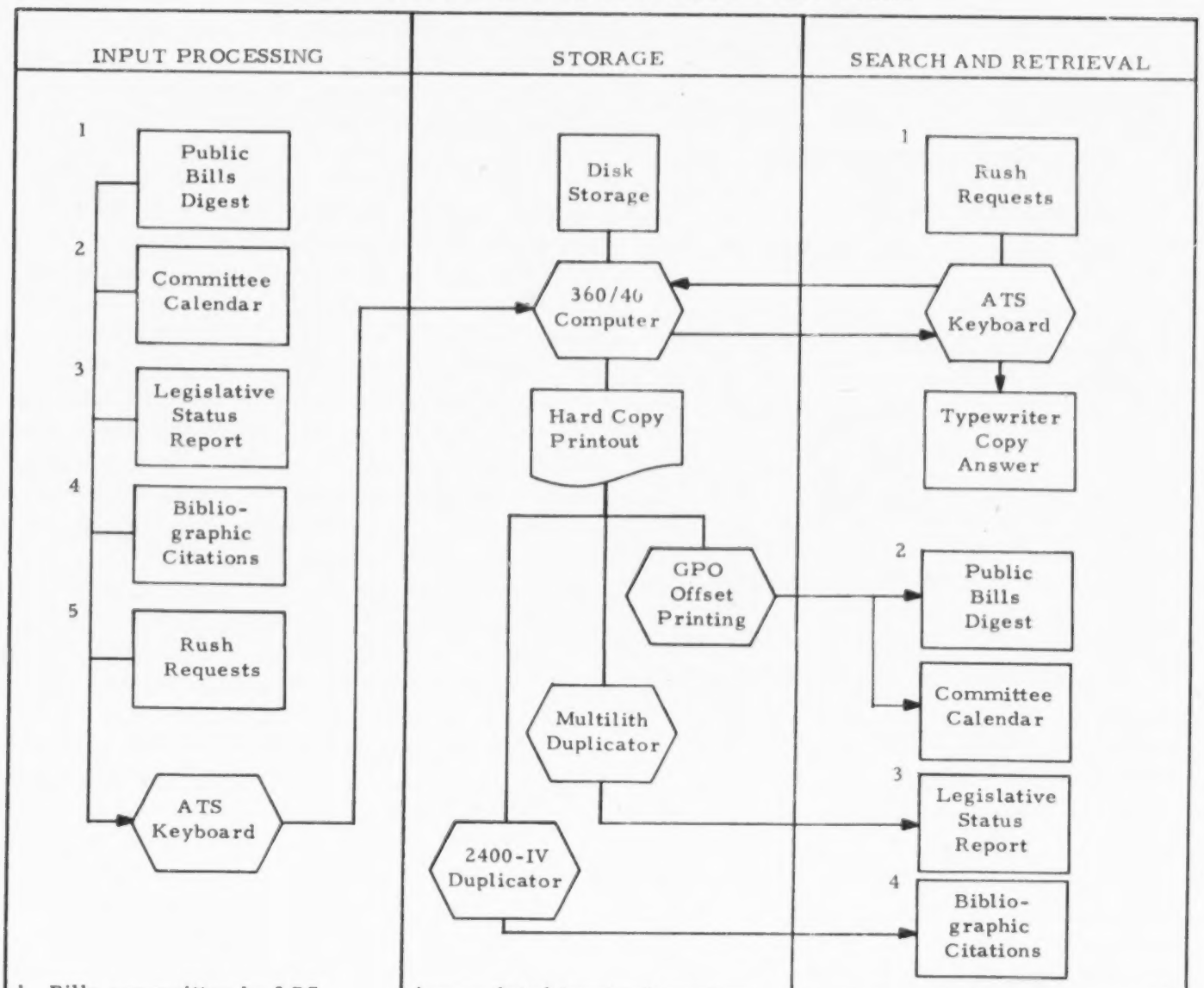
endars." Additionally, bibliographic reports in the form of a weekly list of about 10 significant citations is disseminated on a selective basis to individuals whose areas of subject matter interest match the indexing terms covering the contents of the selected citations. About 190 personnel in the Legislative Branch are currently using this service.

Currently there are 29 active remote ATS terminals involved in the overall system. Of these, 23 are located in LRS and two are located with congressional committees.

REMARKS. As the complexity and diversity of the tasks confronting the Congress increase, the importance of utilizing every possible means of acquiring and analyzing selected priority information before making decisions will become increasingly critical. The role of electronic technology will assume broader proportions as the legislator strives to fulfill his responsibilities and is willing to rely upon support from such systems.

The above-cited examples are only the start of a greater utilization of the benefits of computer and associated technologies. For example, during 1971, Data Central—a powerful, full-text, on-line retrieval system—will be used for retrieval of bill digests and legislative status information. The bill digest data base is already available in the computer as a by-product of the current "Bill Digest" production.

CONGRESSIONAL INFORMATION NETWORK



1. Bills are written by LRS attorneys and periodically stored in 360/40 computer system through use of ATS remote terminal system.

2. Calendars are made up and input to storage using ATS remote terminal system.

3. Legislative status report material covering 200 to 300 major bills are input to storage using ATS system.

4. Bibliographic citations, about 10 per week, are input to storage using ATS system.

5. Congressional "rush requests" are directed to appropriate LRS action offices using ATS remote terminal system.

Accumulated input information is stored on model 2314 Disk Storage component of the 360/40 computer system. Total system has capacity for storing over 233-million characters.

1. Congressional "rush requests" are acted upon by appropriate office and answers received on requester's ATS system in typed paper format.

2. Output from storage is converted to offset printed copy by GPO and disseminated to addressees.

3. Output is reproduced in-house on multilith duplicator and distributed to users.

4. Output information is reduced in size through use of model 2400-IV Duplicator and copies are sent to about 190 LRS and Congressional users.

NAME OF SYSTEM:

Machine Readable Catalog Dissemination (Project MARC)

ORIGINATOR:

Information Systems Office

Library of Congress

Washington, D.C. 20540

OBJECTIVE. To develop and implement techniques and methods for converting source catalog card data into machine-readable form to improve library service nationwide.

BACKGROUND. As the name implies, the first responsibility of the Library of Congress is service to Congress. One department, the Legislative Reference Service, functions exclusively for that purpose. As the Library has developed, its range of service has come to include the entire Government establishment, as well as the public at large, so that it has become, in effect, a national library for the United States.

As we enter the 1970's, libraries across the nation are feeling the effects of the information explosion. The profusion of books, journals, analytical reports, and miscellany threatens to overwhelm even the most sophisticated information handling centers. Conventional library methods are presenting problems to the librarians and users alike. Among these problems are the preparation, maintenance, and searching of the 3 x 5 inch catalog or index cards, and preparation of shelf lists, control records, etc.

Computer technology now possesses the proven potential to support the library community in a number of application areas. Among several studies and applications currently being conducted by the Library of Congress is the MARC (*MA*chine-*R*eadable *C*ataloging) system that is now serving 90 subscribing libraries with weekly distribution of bibliographic data in machine-readable form.

THE NEW METHOD. The MARC System converts records for selected current catalog card entries into machine-readable form and distributes the information on magnetic tape reels to participating libraries around the Nation. The library participants, in turn, use these records as input for their local catalog card processing requirements.

The MARC tape distributed to participants contains separate files of information such as the machine-readable catalog record; an abbreviated author-title record, to include the Library of Congress catalog card number; and subject and descriptive cross-references for tracing records generated by the machine-readable catalog record. The machine catalog record includes all the data with which the cataloger and reference librarian have long been familiar, as well as certain new data elements that provide for augmented approaches to the catalog.

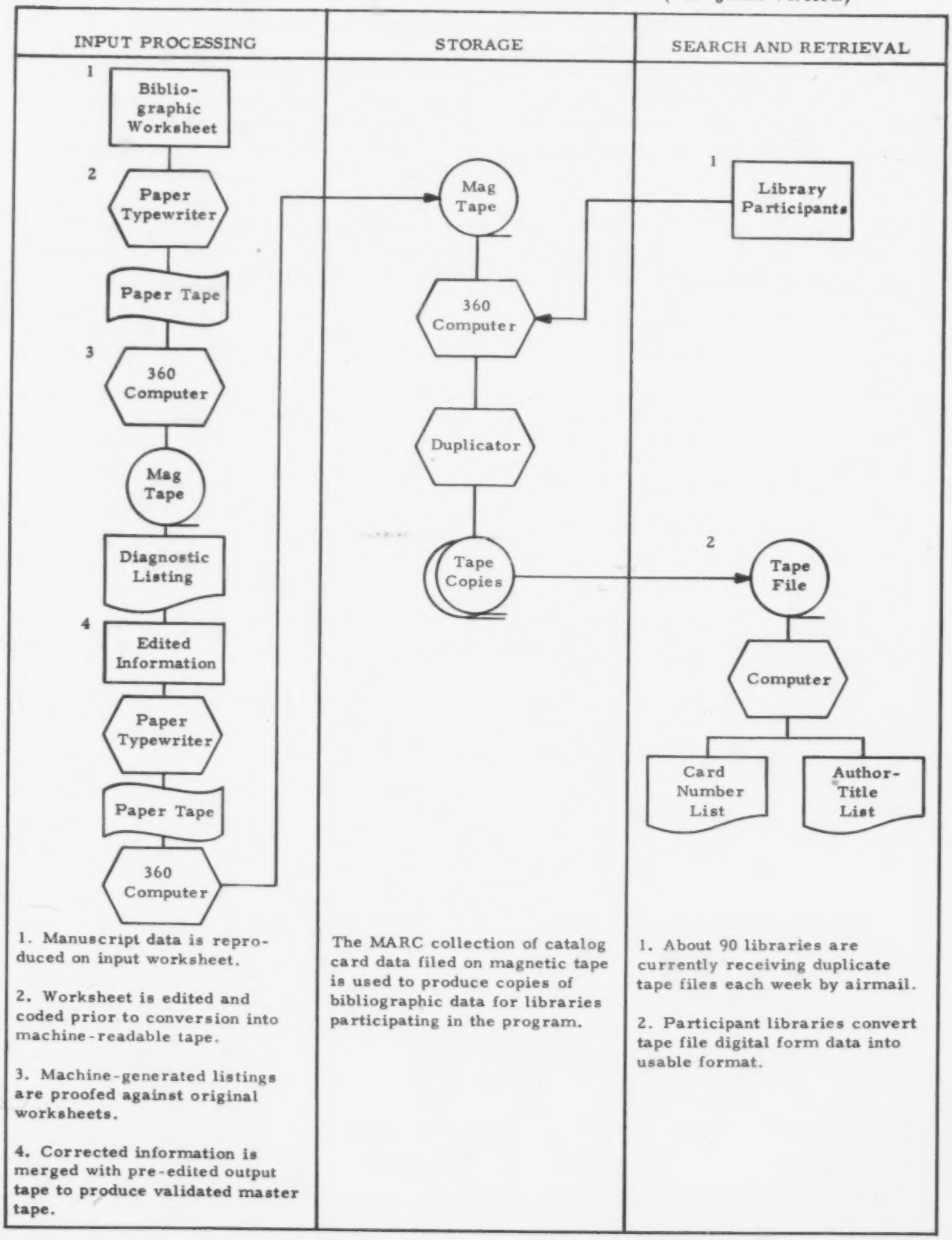
Processing within MARC begins with the receipt of a bibliographic record in the form of a reproduction of the card prepared by the Library of Congress catalogers. This card, used to produce the typeset Library of Congress catalog card, is reproduced on an input worksheet and becomes the source data for the MARC System. The worksheet information is edited, punched on a paper tape typewriter, and converted to magnetic tape. The data undergo both a daily and weekly processing cycle prior to output as a MARC master tape record. The master tape is then duplicated for distribution to participating libraries weekly.

REMARKS. One immediate result of the distribution of the MARC tapes has been the stimulation of interest in the concept of library data transmission. It has become evident, for example, that the MARC system has suggested to the library community the possibility that individual libraries can use a MARC-like system to contribute their own cataloging data for the use of others. Libraries will not only receive data from a centralized source like the Library of Congress, but they also may send data. This feature would bring much closer to reality the long anticipated concept of a network of libraries that can create and utilize a common data base.

A library participant, in evaluating the early results of the MARC Pilot Project, estimated that the system will minimize the searching, editing, keypunching, and verifying for about 24,000 volumes during the year. The MARC magnetic tape record represents a valuable potential for reducing operating costs and improving service since it can be used in a wide variety of ways, such as the automatic preparation of index cards, purchase orders, shelf lists, book spine labels, and charge-out cards; automatic searching of index records by computer; and on-line searching using remote terminals.

This example of dissemination of catalog data in digital form between the Library of Congress and the growing number of participating libraries throughout the Nation is only the forerunner of many additional library applications to be developed over the next few years. Since many of these concepts have application in the office world, their progress should be watched closely.

MACHINE READABLE CATALOG DISSEMINATION (PROJECT MARC)



1. Manuscript data is reproduced on input worksheet.

2. Worksheet is edited and coded prior to conversion into machine-readable tape.

3. Machine-generated listings are proofed against original worksheets.

4. Corrected information is merged with pre-edited output tape to produce validated master tape.

The MARC collection of catalog card data filed on magnetic tape is used to produce copies of bibliographic data for libraries participating in the program.

1. About 90 libraries are currently receiving duplicate tape files each week by airmail.

2. Participant libraries convert tape file digital form data into usable format.

NAME OF SYSTEM:

Aerospace Information Dissemination

ORIGINATOR:

Office of Technology Utilization

Scientific & Technological Information Division

National Aeronautics and Space Administration

Washington, D.C. 20546

OBJECTIVE. To assure that scientists and engineers working on NASA's advanced aeronautical and space projects, as well as other interested institutions and individuals, are kept informed of significant developments in their areas of interest and to provide a rapid economical means for obtaining needed information.

BACKGROUND. The NASA Office of Technology Utilization is responsible for the collection, processing, and communicating of scientific and technical information resulting from space program experience. Much emphasis has been directed toward placing this vast collection of knowledge in the hands of those who would explore its nonaerospace applications. Thus the information program managers have broadened the base of interest to a marked degree. The current Master Authority Address List reveals that an audience of over 2,700 public and private institutions are interested in NASA's collection of documents and publications.

THE NEW METHOD. The NASA information collection comprises more than one-half million documents and publications. This collection encompasses acquisitions from Government, industry, research institutes, and the academic community. In addition, NASA regularly receives technical literature and specialized reports covering various projects, laboratory findings, and new patent information.

Hundreds of additions to the document file are received daily at the NASA Scientific and Technical Information Facility at College Park, Md. Each document accepted as a potentially valuable addition is first given an accession number for control purposes. Those documents with a potential of broad interest are selected for conversion to microfiche format. Indexers then examine each selected document for pertinent bibliographic data and select the terms under which the document will be listed in the index. Abstractors review each newly-received document and develop appropriate abstracts, or may rewrite the abstract that accompanied the document if it does not conform with NASA standards.

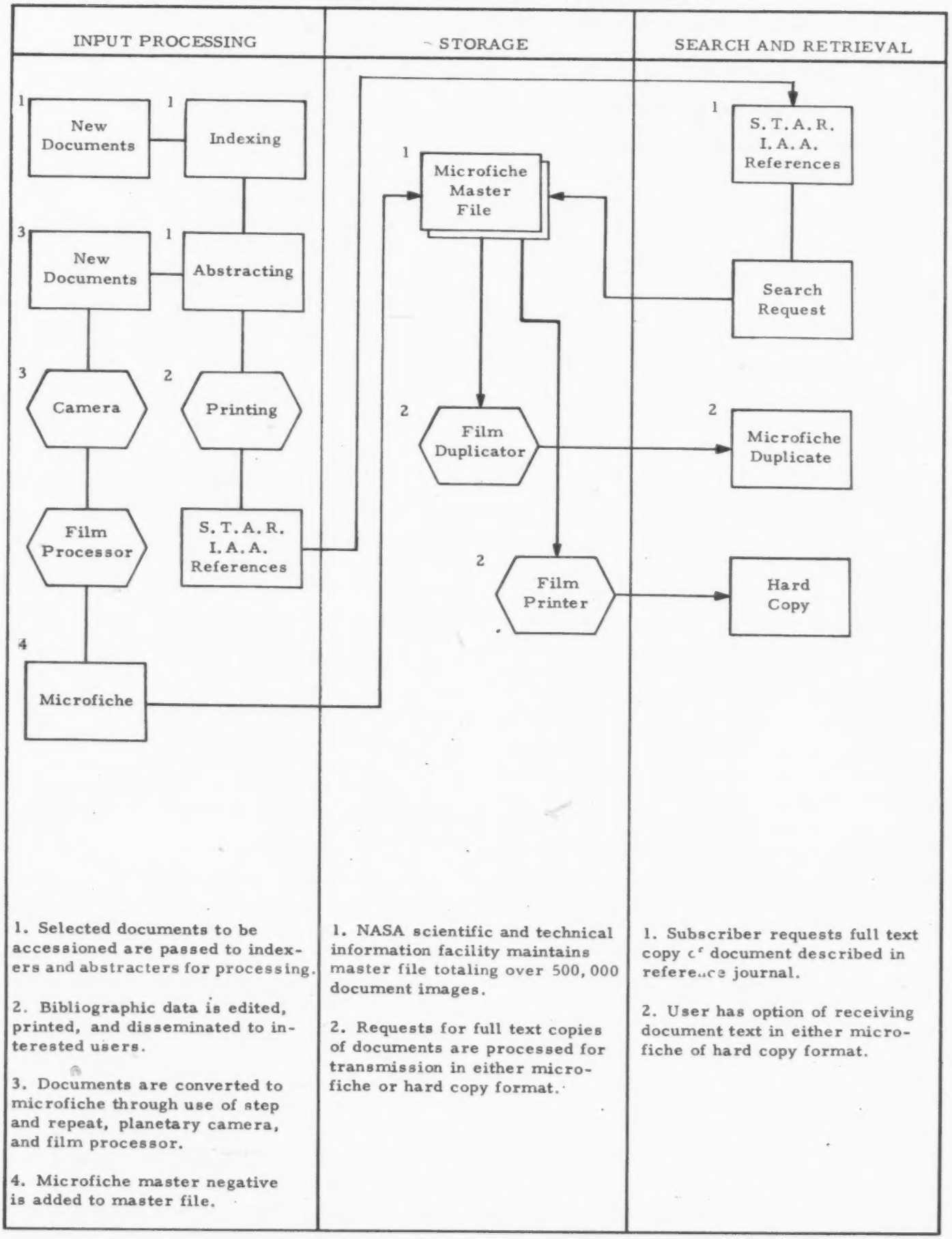
The microfiche is roughly 4 x 6 inches and conforms with the COSATI (Committee on Scientific and Technical Information) microfiche standards. The distribution copy consists of a diazo sheet of negative film carrying images of as many as 60 pages. The bibliographic citation of the document appears in normal size print across the top.

The most widely used reference guides to the NASA scientific and technical information system's growing file of knowledge are two complementary bibliographical and abstract bulletins, *Scientific and Technical Aerospace Reports* (STAR) and *International Aerospace Abstracts* (IAA). STAR abstracts cover worldwide report literature on space and aeronautics, while those in the IAA provide similar coverage of scientific and trade journals, books, and papers presented at meetings. Expert processing and modern methods of printing keep the coverage of both journals remarkably current. Indexes are organized to show subjects pertinent to a variety of disciplines.

Users of the STAR and IAA document reference services may identify a desired document by citing its accession number. In addition to the accession number, the bulletin also includes such bibliographic information as the corporate source, the title of the report, and an abstract of the report. Requesters may order a microfiche copy of the document or an enlarged paper copy. In most instances, the microfiche copies cost substantially less than the paper reproductions.

REMARKS. Without the benefits of microfilm as a storage and dissemination medium, it would almost be impossible to effectively serve the scientific and technical community. In addition to the problems of making, assembling, and warehousing paper copies, the packaging and shipping would represent a formidable effort. Fortunately, the steady improvement in microfilm technology has made it possible for information handling activities to keep abreast of the increased creation of paper documents. In 1969 NASA distributed almost 10 million microfiche under its information dissemination program. This in itself was a gain of almost one million microfiche over the previous year's total.

AEROSPACE INFORMATION DISSEMINATION



1. Selected documents to be accessioned are passed to indexers and abstracters for processing.

2. Bibliographic data is edited, printed, and disseminated to interested users.

3. Documents are converted to microfiche through use of step and repeat, planetary camera, and film processor.

4. Microfiche master negative is added to master file.

1. NASA scientific and technical information facility maintains master file totaling over 500,000 document images.

2. Requests for full text copies of documents are processed for transmission in either microfiche or hard copy format.

1. Subscriber requests full text copy of document described in reference journal.

2. User has option of receiving document text in either microfiche of hard copy format.

NAME OF SYSTEM:

NASA-RECON Automated Reference

ORIGINATOR:

Office of Technology Utilization

Scientific & Technological Information Division

National Aeronautics and Space Administration (NASA)

Washington, D.C. 20546

OBJECTIVE. To develop a document reference system that will increase efficiency in the dissemination and use of NASA's large collection of scientific and technical information.

BACKGROUND. Since 1958 NASA has been discovering new things about materials, machinery, and human beings, as well as about the earth, the moon and the universe. The responsibility for collecting, maintaining, and identifying the documentary results of these worldwide aerospace research activities rests with NASA's Scientific and Technical Information Division. In performing these most important duties the Division personnel summarize, index, and store this wealth of knowledge for the benefit of a broad array of people associated with scientific and technical pursuits. Each day the NASA Scientific and Technical Information Facility at College Park, Md., receives hundreds of scientific and technical documents. These papers are promptly checked to avoid duplication and examined for relevance. Professional indexers examine each document as it enters the system and record its appropriate reference data, including selection of authorized indexing terms. Trained abstractors then write a short but valid resume of the document's contents in cases where such action has not been taken previously. After a final review, the complete bibliographic record is entered into the memory of a high-speed electronic computer.

NASA's current information file numbers several hundred thousand documents, with most of the material maintained in microform. An analysis of the various users of this large body of information shows that NASA and its related industrial firms are involved in 60 percent of the total research inquiries. The academic community follows with 21 percent, and other Government agencies and foreign users are involved in the remaining 19 percent.

With the continuous growth of the Central File's accessioned scientific and technical material, researchers were spending an increasing portion of their time in locating meaningful document information. To alleviate this condition, the NASA authorities established the RECON system after an in-depth study of advancements in computerized information retrieval applications.

THE NEW METHOD. The NASA-RECON (*RE*mote *CON*trol) Automated Reference System consists of a high-speed computer and its stored bank of reference information located at College Park, Md., plus 21 remote information terminals located at selected aerospace centers throughout the United States. Each terminal complex includes a keyboard for entering queries into the system, a cathode-ray tube (CRT) for visual display, and a teleprinter for printout. The system has the capability of giving the NASA scientists and engineer users real-time, on-line machine access to specific reference data pertaining to NASA's Information Facility.

In preparing to use the RECON system's bibliographic data, the user must choose his inquiry terms from the NASA Thesaurus (list of indexing terms), available at each terminal location. This Thesaurus contains several thousand terms, many of which specifically relate to aerospace disciplines. Aside from these alphabetically-arranged terms, several related appendixes are also included in the same volume. These are a permuted KWIC (keyword-in-context) index; a list of subject terms by subcategories, and a heirarchical display of broad and narrow terms. Each of these index lists was developed to assist the user in determining which terms to use when conducting his search.

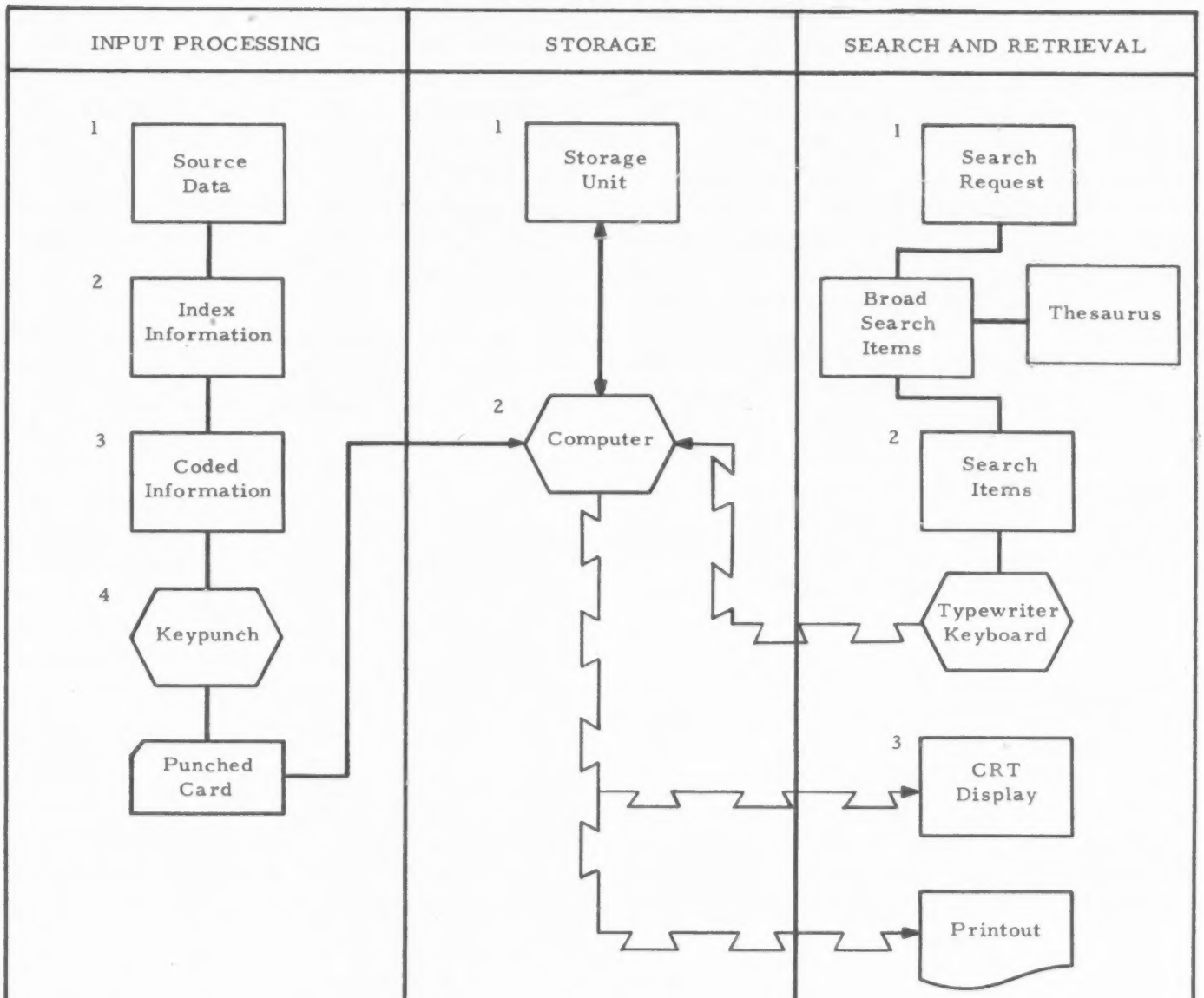
The user starts the search by entering his identification code on the console keyboard and then typing out his search question. Within seconds the bibliographic replies are displayed on the CRT. Depending upon the user's input query, the answer might cover accession numbers and titles, or display a catalog listing of information on a particular scientific discipline. If the list is long, he can instruct the computer to printout the selected citations on a printer located next to the CRT.

As an example of the system's flexibility, suppose a user needed detailed information on an ultrahigh-frequency radio transmitter used on a Lincoln Experimental Satellite. The search could be conducted under three indexing terms: Lincoln Experimental Satellites, ultrahigh frequency, and radio transmitters, terms that can be recognized by the computer. In response to how many documents were indexed under these terms, the CRT display showed ten under the first, 93 under the second, and 110 under the third. The computer could then be asked to display the titles, authors' names and other information on each of the three sets of terms. However, this action would be impractical due to the number of reports. To save time, the computer could be asked to cite the number of documents indexed under all three terms. The computer's reply would quickly reveal on the CRT display that only one document was indexed under the three terms specified. By pushing another button the CRT would show that the item was a 26-page report, dated July 19, 1968, and prepared by Dr. R. E. Jones. With this information, the user would be able to obtain an abstract of the paper or a microfiche copy of the complete report.

REMARKS. This real-time, on-line, time-sharing automated information system with remote access terminals possesses a wide range of coordinate reference capabilities. With proper search preparation on the part of the user, it can be used to correlate and manipulate reference data in a variety of ways to achieve search satisfaction. Its great speed and search flexibility reduce the search time of hundreds of scientists and technicians to a minimum and thus afford them a higher percentage of time for more creative pursuits.

Costs for development, acquisition, and operation of such a sophisticated system are high in relation to other automated retrieval systems. In time, such costs will become lower and thus more competitive as improvements in hardware and programing occur.

NASA/RECON AUTOMATED REFERENCE



1. Technical literature and specialized reports generated by Government agencies, laboratories, and other institutions.

2. Information specialists index each accessioned document in a variety of ways, i.e., author, subject, key terms, etc.

3. Code clerks transform information into coded terms.

4. Information is converted into punched cards and is entered into the computer.

The facility at College Park, Maryland contains over 1/2 million references.

1. The input information is stored on random access storage units.

2. Search information received from remote terminals is interpreted per appropriate computer program and answer sent via leased wire to requesting terminal.

1. Scientists and technicians at 21 remote locations have access to the NASA facility data bank. Initial search requests are defined through use of NASA thesaurus.

2. Search terms compatible with stored terms are entered into the system through use of a typewriter keyboard.

3. Answers to queries are displayed on cathode ray tube display screen and also printed on printout form.

NAME OF SYSTEM:

National Marine Data Inventory (NAMDI)

ORIGINATOR:

National Oceanographic Data Center (NODC)

2nd and M Streets, S.E.

Washington, D.C. 20390

OBJECTIVE. To establish and operate a system that will assure rapid and economical storage, retrieval, and dissemination of marine (oceanographic) data in various formats to meet a wide variety of user needs.

BACKGROUND. The National Oceanographic Data Center (NODC) was established in 1960 under the sponsorship of 10 Federal agencies, including the Atomic Energy Commission, Coast Guard, Bureau of Commercial Fisheries, Geological Survey, and the National Science Foundation. It was organized to fill the needs of Government, industry, academic and research institutions, and the public for "an efficient mechanism for processing, exchanging, and storing globally collected marine data and information." The collection of oceanographic data originates with many domestic and foreign organizations. The information collected encompasses such subject matter as geological sampling, marine biology, surface ocean current information, and oceanographic station data.

Because NODC's in-house data processing capabilities were originally unable to satisfy the information storage and retrieval requirements, the Center for many years shared computer time with the Naval Research Laboratory and the Department of the Treasury. As national interest in environmental and oceanographical disciplines increased during the latter half of the 1960's, it became apparent that NODC would need to augment its in-house computer processing capability. Consequently, the Advisory Board to NODC recommended acquisition of a "medium scale" third-generation computer system. A System 360 Model 40 was installed in late 1969 and is now handling many of the Data Center's more demanding data processing requirements.

THE NEW METHOD. The National Marine Data Inventory (NAMDI) system is but one of many data and information collection and disseminating services offered by NODC to the wide diversity of interests in the oceanographic field. The NAMDI inventory contains quantitative information on all types of "ocean station" data and samples collected during 1,500 U.S. research and survey cruises occurring since 1960. The information is compiled from summaries provided by about 40 Federal and institutional activities. A policy of expanding the source base of inputs has been pursued for some time, with a view to eventually including the entire U.S. marine data-gathering effort.

The basic inputs to the program cover three categories of information and data as follows: the "Master Card Record," concerning the cruise, station, and associated surface meteorological data; an "Observed Depth Card," containing data observed at a particular depth in the ocean; and a "Standard Depth Card," covering both computer and observed interpolation of values. The information is periodically forwarded to the Data Center for conversion to punched card format for entry into the computer data bank. The inventory file is now updated monthly as a result of the recent increase in computer capabilities.

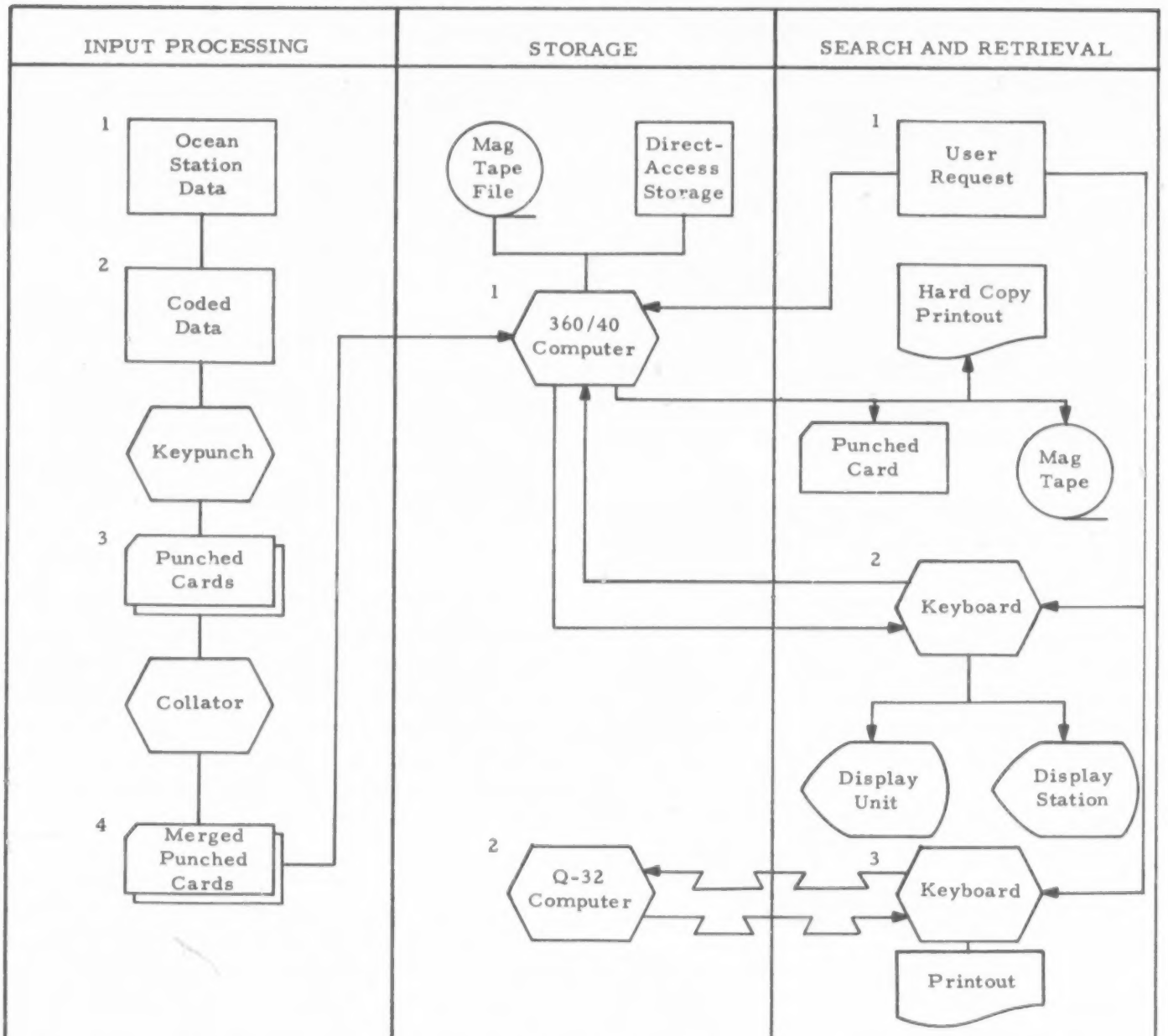
The full NAMDI inventory comprises 13 separate program libraries, tailored to meet individual user's needs. An archival file is maintained in both punched card and magnetic tape formats. The inventory data can be provided to users on machine-generated printouts, punched cards, and magnetic tapes.

As a result of daily requests from the oceanographic community for specific data, the NAMDI has been processed into a remote time-sharing computer. Communication with the computer is by NODC teletype-dataphone, in English, followed by simple rules

for sentence construction, which obviates the need to use programing language.

REMARKS. The new on-line direct access storage facility provides the Data Center with the capability to retrieve in a given moment large volumes of information in the form of summaries, inventories, and large segments of the basic file. The new computer capability also provides expanded programing capacity required to serve the needs of the oceanographic community and permits closer interaction between users and the new NODC facility.

NATIONAL MARINE DATA INVENTORY



1. Data forwarded to NODC in specified format.

2. Data in coded form is key-punched, verified, and converted to punched card format.

3. Punched cards are merged with working deck and held for monthly updating action.

4. New updated punched card deck converted to magnetic tape format.

1. The National Marine Data Inventory File is contained on punched cards and magnetic tape. Selected data is stored on direct access replaceable magnetic disk packs.

2. Generalized data stored on vendor Q-32 timesharing computer in Santa Monica, Calif.

1. User may obtain complete updated file of inventory data in a variety of formats to include hard copy printout, punched cards, and magnetic tape.

2. User desiring selective graphic displays of data and information may communicate directly with computer through graphic input-output consisting of a CRT, light-pen, and functional keyboard, or alpha-numerical information on display station.

3. User desiring selective data may communicate with computer from remote teletype-dataphone.

NAME OF SYSTEM:

Automated Name Search

ORIGINATOR:

Securities and Exchange Commission (SEC)

Washington, D.C. 20549

OBJECTIVE. To operate an automated name index search system that will eliminate data duplication, reduce timelags in processing of cases, and thus increase the effectiveness of the Commission's clerical and professional personnel.

BACKGROUND. The Securities and Exchange Commission (SEC) is a regulatory agency of the Government responsible for protecting the interests of the public and investors against malpractices in the Nation's securities and financial markets. In performing these varied duties, the Commission is interested in such matters as company registrations, corporate financial statements, stock exchange activities, and brokerage house operations. As an adjunct to regulating these financially oriented institutions and activities, a large file on individuals associated with these enterprises is maintained.

Several years ago, due to an increase in workload and prospects of an expanded area of subject matter interest, the SEC requested the Office of Records Management, National Archives and Record Service, to conduct an in-depth study of its paper handling activities. The survey conclusions, among other suggestions, recommended that the various widely dispersed record collections be centralized. For example, index cards created and maintained by operating divisions as aids in processing their work totaled 20 separate files. A contributing factor to the workload problem was the limited amount of data that could be recorded on the index cards. For example, because social security numbers were not contained on the cards, it was often impossible to identify particular individuals from a listing of apparently identical names. Further, the card file system had no manipulative features that could help in revealing relationships between individuals and a particular case file.

Collectively, about 30 man-years were required to maintain and service the 1.5 million personnel cards, indexes, and case records. The index cards contained from one to six items with information such as name, file number, and cross-references.

Based on the findings of the survey, the Office of Records Management recommended establishment of an automated information storage and retrieval system. In addition to the personal index data needs, the equipment would also be used to effectively handle other file maintenance requirements within the SEC.

THE NEW METHOD. The new system is oriented around the name search file, which is an automated index collection of information extracted from the various documents and files of the Commission. The file collection is used primarily for developing association and relationship data between individuals and companies.

The initial conversion of the index card file collection was to punched cards. After data validation and necessary corrections, a computer-oriented alphabetical magnetic tape index file was produced, which serves as the principal data source for the name search process.

Name and case number inputs to the automated, master index file are extracted from selected cases and transcribed on a transcript sheet form. Keypunch operators convert the information to punched card format. After alphabetical batching, the punched cards serve as the computer input for merging the information into the index file master tape.

Computer name searches are initially processed in the same sequence as is the input source data. The computer searches each name entry for matches or near matches against the master index file. In instances where matches or near matches occur, an

additional computer program causes case file numbers of such names to also be identified. The retrieval of the information is in the form of a computer printout and is used by the searcher to identify and obtain the appropriate case documents for possible relationships or association purposes.

REMARKS: The magnetic tape file system was selected because of the quality, repetition, and the diversity of data characteristics needed by the SEC's examiners, attorneys, and other personnel. The data is needed in a quick, accurate, and usable form and at a reasonable cost. The former system of manually maintained records was too costly in terms of manpower, quality of results, and timeliness of action.

The computerized magnetic tape file provides quick and accurate responses to name checks, and is the most effective way of developing individual relationship and association data. By proper scheduling of inputs the computer search program can perform this type of search requirement in a matter of hours, in contrast to the manual effort which often took days to complete.

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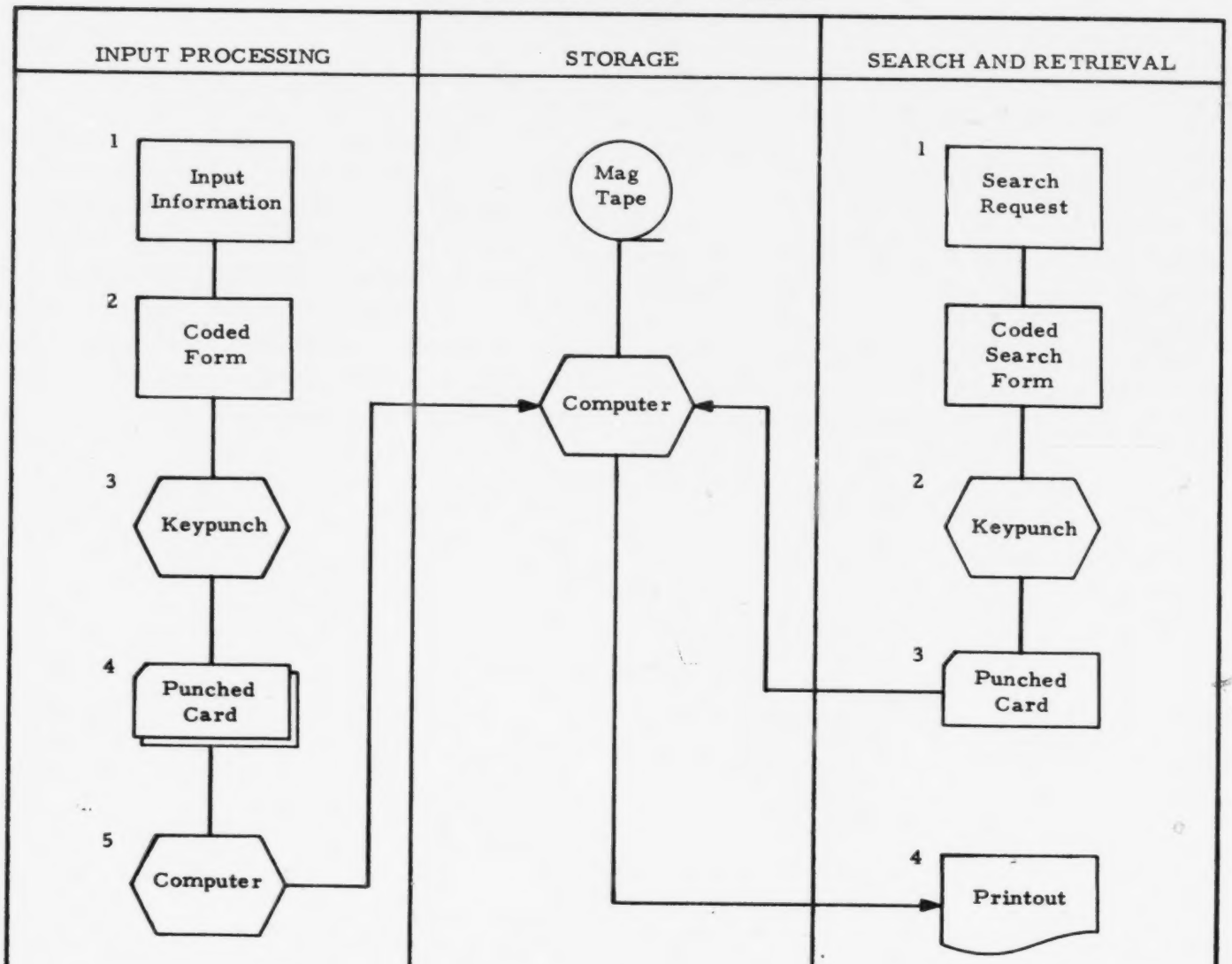
AUTOMATED NAME SEARCH



1. Input consists mainly of names of people associated with financially oriented activities.

2. Information is extracted from source media and placed on partially coded form.

3. Keypunch operator converts information into punched card format.

4. Punched cards are batched and serve as input to computer.

5. Computer program merges new information into proper sequence in master index file.

Master index file contains more than one million entries.

1. Name search requests are entered on search form.

2. Keypunch operator converts information into punched card format.

3. Punched cards are batched and run through computer for name matching and associated information.

4. Retrieved information is received as a hard copy printout of matched names and file identifications.

NAME OF SYSTEM:

Animal Inventory Management

ORIGINATOR:

National Zoological Park
Smithsonian Institution
Washington, D.C. 20009

OBJECTIVE. To establish a simple, economical, and effective document reference system that will give immediate access to the current inventory of and information on the National Zoological Park animal population. To also assure a system capability for limited manipulation of data about animals to meet unpredictable research or other needs.

BACKGROUND. The National Zoo currently maintains and manages a group of about 3,200 animals. In supervising this unusual activity, veterinarians, administrative personnel, and the many animal keepers need access to a large array of information on individual animals and various animal groups. Each of these user groups need both specific as well as general data on unpredictable animal happenings or events. The former conventional method of maintaining information on the zoo population made it difficult to readily correlate, compare, or analyze data in the desired manner.

THE NEW METHOD. The Animal Inventory Management System uses an 8 x 10 inch, edge-notched card form containing 166 coding positions as the basic index reference media. The cards are made in sets consisting of the basic card and two 5 x 8 inch carbon interleaf card forms containing 80 coding holes that serve as duplicate reference files. The larger edge-notched card is maintained in the Chief Veterinarian's Office, while the two smaller cards serve the index reference needs of the Administrative Office and the Animal Keeper's Office.

Under the edge-notched card system a separate card is maintained for each animal in the Zoo. For ease of identity, cards at each of the three file locations are color-coded—blue for birds, white for mammals, and beige for reptiles. The color code permits the file to be readily divided into the three categories, thus aiding both the card filing task as well as the reference search request. While this card filing arrangement is basically equivalent to a conventional card filing system, the coding characteristics of the edge-notched card system give the file its nonconventional classification.

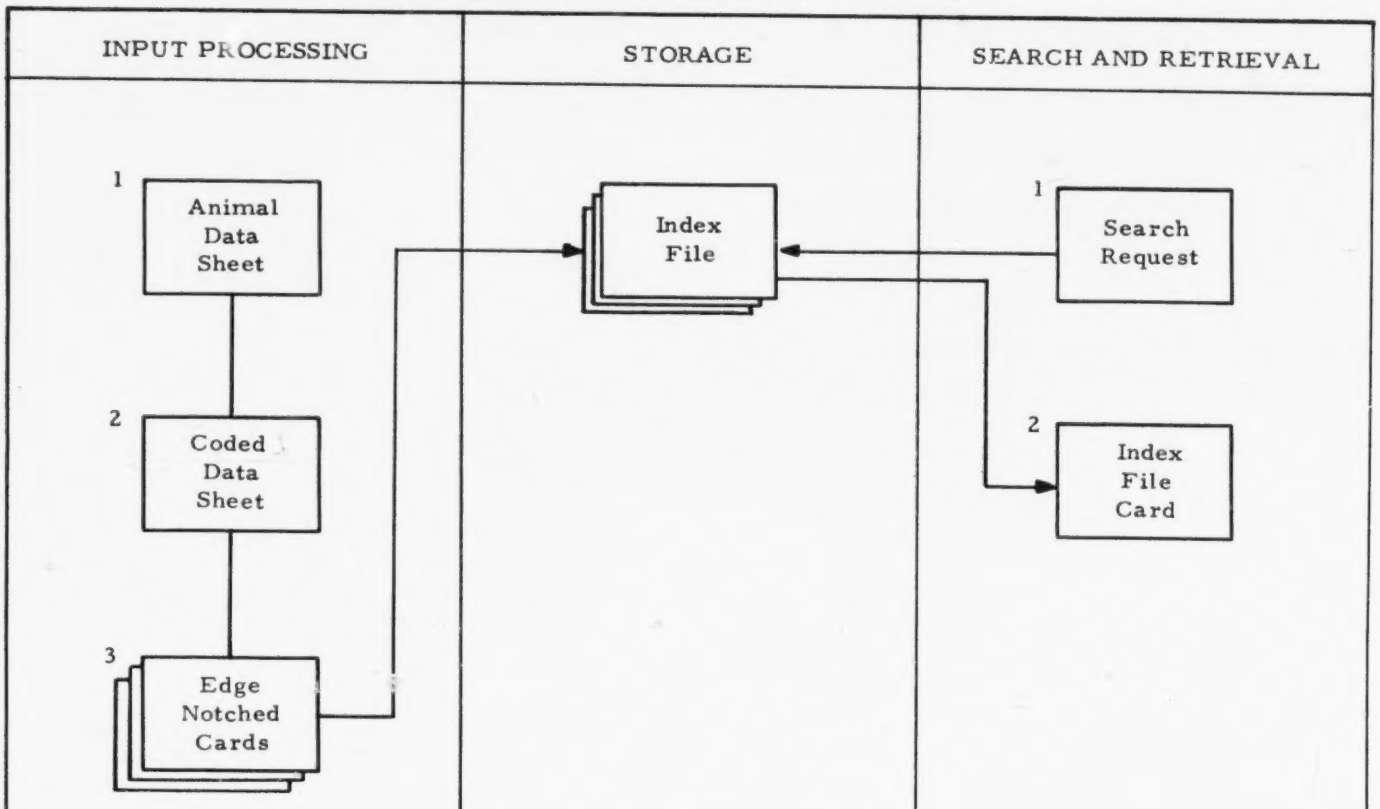
General information is typed on these cards in the conventional manner. However, the various animal attributes are entered into the master card by means of a hand punch. This punch "notches out" the specific holes that comprise the codes representing the attributes of each animal. The codes cover such animal information as identity, receiving date, method of acquisition, vaccination status, health status, and departure date.

When looking up information concerning a particular animal, the file is searched in the conventional manner. However, when conducting searches on the basis of any of the coded animal attributes, the full value of the edge-notched card system is apparent. As an example, a veterinarian may wish to know the identity of all tigers having a certain immunization profile. Initially, the searcher would isolate all the white index cards representing the mammal category. He would next use the "needle search" technique to select the edge-notched cards for all tigers from the mammal portion of the file. Finally, a second needle search would "drop out" all tiger cards meeting the immunization code criteria. With the identity of this select group of animals now known, the veterinarian would take his planned action.

REMARKS. This edge-notched card reference method is an inexpensive, simple system having minimum equipment requirements, and it can be operated by personnel without special skills or training. The system offers a limited ability to manipulate data for unpredictable purposes and may be updated to

reflect animal inventory changes. It also has features that allow for easy duplication of the master file with a minimum of additional cost or effort. A limiting condition inherent in this system is the loss of search efficiency when the file size approaches 3,000–5,000 cards. At that point the needle search process becomes increasingly slow and tedious.

ANIMAL INVENTORY MANAGEMENT



1. Clerks record appropriate administrative and animal data on worksheet. 2. Clerks convert specific data to coded form on worksheet. 3. Clerks punch coded data into proper areas of index cards. Administrative data typed under proper headings. Index sets include one master and two subordinate files.	The master animal file is maintained in the veterinarian's office. The smaller files with 80 coding positions are used by the administrative office and animal keeper's office.	1. Clerk retrieves appropriate cards by either conventional methods or by use of needle-search technique. 2. Retrieved cards are viewed by user.

NAME OF SYSTEM:

National Driver Register

ORIGINATOR:

Federal Highway Administration
Department of Transportation,
Washington, D.C. 20590

OBJECTIVE. To establish and maintain an information storage and retrieval system that will facilitate central collection, flexibility in searching, and rapid dissemination of selective data on the Nation's motor vehicle drivers.

BACKGROUND. The National Driver Register was established by the Congress in 1961 to provide Federal assistance in driver licensing while maintaining State autonomy as to the extent of participation. The Register provides for a central driver-records identification containing the names of drivers whose licenses have been revoked or suspended for a number of causes. State participation in the system is voluntary. The Register operates purely as a service agency with the States retaining full administrative authority over driver licensing. Only authorized State and Federal officials can obtain information from the Register.

Before the Register's establishment there was no practical way for the State administrators to obtain records of driver license applicants whose licenses had been revoked or suspended by other States. A few States had reciprocal driver record exchange agreements, but this arrangement left much to be desired. Under this new system each State is given a basic procedural guide covering all aspects of the system, including state responsibilities for making the Register effective and the benefits to be derived from participation.

THE NEW METHOD. In brief, the new system can best be decribed as an authentic "information loop," as each State contributes to the Register and also receives important information from the system's growing data bank.

Submissions from the States consist of three types of inputs and one search and retrieval process. The inputs are withdrawals (and denials) of drivers licenses, recisions of withdrawals, and restorations of drivers licenses. The search processing performed for the States is called "Report of Withdrawal Searched" and is a report of a driver license revocation discovered during the search of the Register's master tape file.

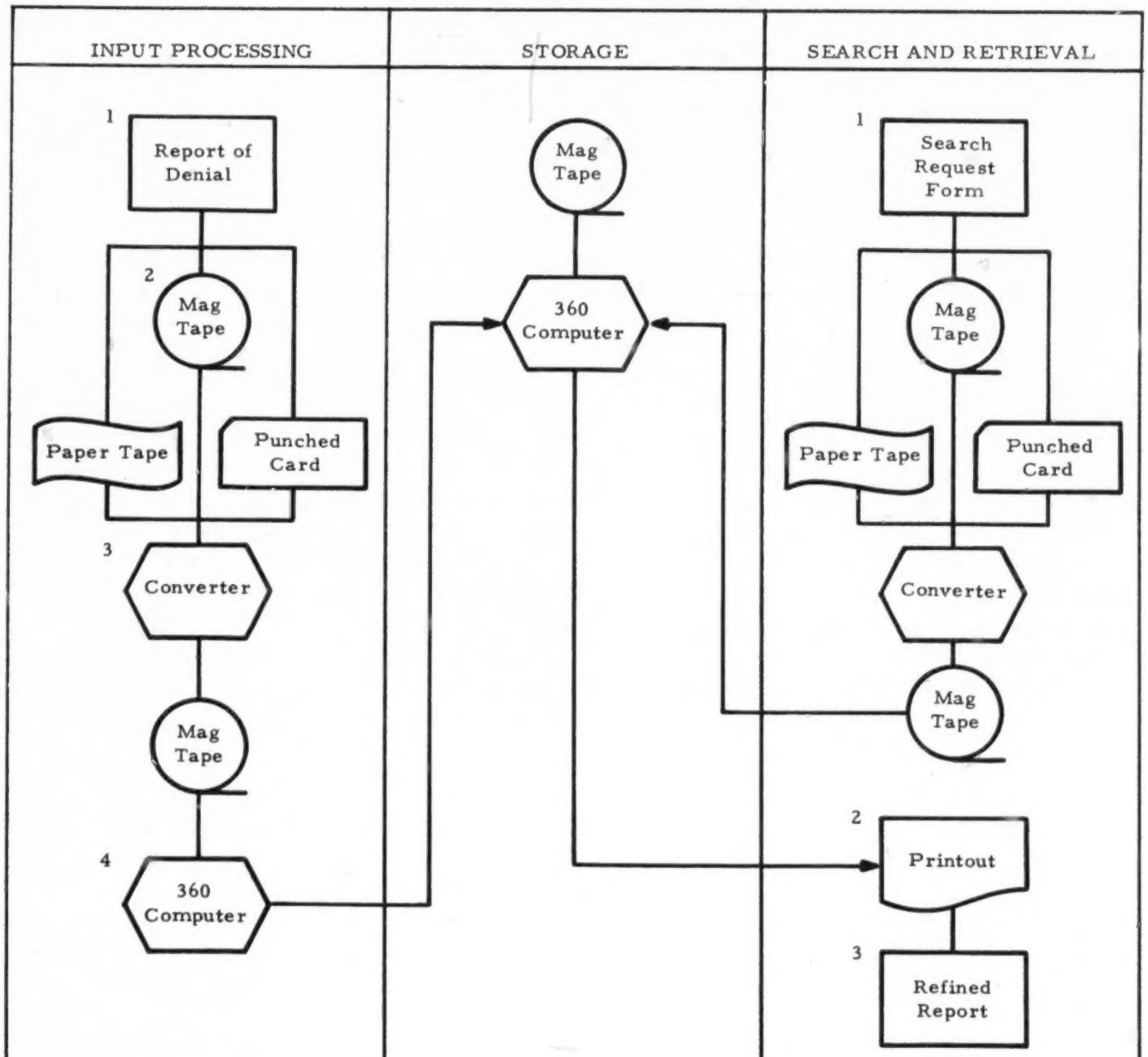
The key State inputs to the system are name and place of birth. Other identifications include such personal characteristics as color of eyes, height, and age. The standard amount of information required creates a need for at least two punched cards, and when multiple names have been used by the applicant, as many as five cards are necessary.

Although all States participate in the program and the Register has appropriate standard forms available for each type of transaction, the State submissions are typically received in a variety of formats, including paper tape, punched cards, and magnetic tape. Additionally, the content of State submissions varies to some degree. The conversion of this large volume of daily submissions to magnetic tape is performed by a local data searching organization. In the search process, the daily receipt of State requests for "license denials" are batched and run through a series of processes that convert the information to a magnetic tape machine-language medium. This tape is then programed and run against the master file for matching action. The computer search programs are highly sophisticated and flexible. For example, the system can automatically check for names that are spelled slightly differently and for numerous other alterations that applicants sometimes use to disguise their true identity. The list of verified matches of driver license revocations and denials are forwarded daily by air mail to each State.

Approximately 75,000 inquiries are received each day concerning such license revocations or denials, and of this number about 15 percent result in name matches.

REMARKS. The computer's capability to conduct programed coordinate searches of the master file for specific information is a natural for the scope and nature of this National Driver Register system. Additionally, the master file may be expanded or purged with only routine effort. The continuing problem in this operation has been the difficulty in obtaining standard input format submissions from the States.

NATIONAL DRIVER REGISTER



1. Reports of license denials and associated reports received by mail each day at National Driver Register.

2. Submissions are forwarded in a variety of formats.

3. Data service contractor converts the variety of submissions to magnetic tape compatible with in-house computer program.

4. Computer Services Division merges daily inputs into master tape file.

National Driver Register is serviced by IBM 360/65 computer. Master file is maintained on magnetic tape.

1. Search requests are in the same formats as input reports and are processed and converted into magnetic tape for compatibility with the search program.

2. Computer search program produces printout, or, near-printout of matched names.

3. Printout is manually checked to insure compatibility of names. A refined report is mailed daily to appropriate States.

NAME OF SYSTEM:

Automated Merchant Vessel Report (AMVER)

ORIGINATOR:

Eastern Area, U.S. Coast Guard

Custom House, New York City, New York 10004

OBJECTIVE. To improve coordination and rescue operations at sea by being able to rapidly store, retrieve, and communicate essential data concerning the locations and capabilities of ships that may be called upon to render emergency assistance to those in distress.

BACKGROUND. Two of the many functions and activities of the Coast Guard are conducting search and rescue operations and assisting vessels and aircraft in distress. In performance of these responsibilities the Coast Guard for many years manually maintained a plotting chart of Eastern coastal waters for those ships for which agents submitted itineraries. Positions taken from weather reports were used to increase the accuracy of vessel plotting. Where regular Coast Guard forces were not adequate, appropriate merchant ships were asked to provide assistance during search and rescue (SAR) operations. The density of ships in the area and the size of the plotted area were small, but the potential for an enlarged mutual assistance program was readily apparent.

When a relatively low cost computer with a random-access disk memory file capability became available, the time seemed feasible to automate the plotting activity and to evaluate the SAR potential for assisting a larger number of ships. Electronic data processing equipment was installed and the AMVER System was established in July 1958. The number of ships plotted and the accuracy of their dead reckoning positions were increased by use of radio stations to relay sail plans from the ships to the Ship Plot Center. These radio sail plans included departure place and time, routing, destination, and average speed of ship advance.

During the next few years both the participation and scope of plot area increased. As a result of the success of the system, an updated electronic data processing system was placed in operation in a new AMVER Center in the New York Custom House in December 1964.

THE NEW METHOD. The AMVER System consists of a network of designated radio stations, Rescue Coordinating Centers (RCC), the AMVER Center, U.S. Ocean Station vessels, and participating merchant ships. Inputs to the system are usually messages received directly in the AMVER Center on teleprinter equipment. This information covers such things as sail plans, position reports, deviation reports, and arrival reports. The information is placed in properly coded format, punched into tabulating cards, verified for accuracy, and entered into the computer for processing, storage, and possible future use. Based on proper programs, the computer generates a special sail plan for each participating ship, or corrects one already on plot, and stores the results on magnetic memory disks ready for use in an emergency. New positions are calculated for each ship at intervals of 12 hours.

When an emergency occurs, the information retrieval capabilities of the system react with great speed. First, the controlling Rescue Coordinating Center requests a Surface Picture (SURPIC) from the AMVER Center using the same teletype network. Within two minutes, the programed computer prints out a SURPIC listing of the appropriate vessels on plot in the specified area to include their predicted positions and rescue capabilities. Simultaneously a punched card is prepared for each ship identified by the computer. The cards are placed in special data transmission equipment that sends the SURPIC by teletype to the requesting Rescue Coordinating Center for use with other available information.

With reference to the SURPIC's, the Rescue Coordinating Center in its initial notice specifies the parameters of the emergency. These factors include the date and time to the nearest hour, the geographical area, and

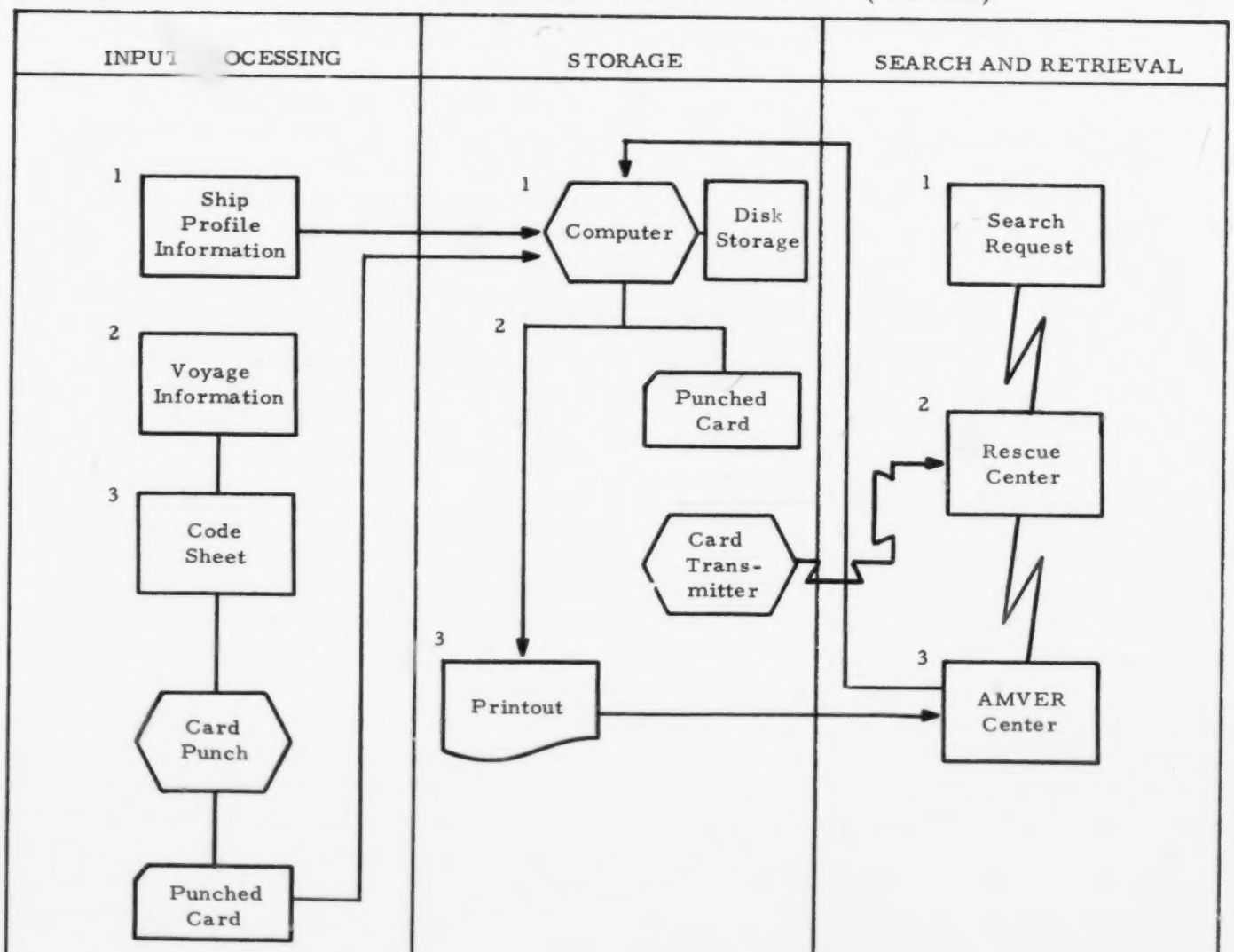
the category of ships involved. The areas of search may be a circle defined by a center point and radius of any number of nautical miles; a rectangle whose sides are specified parallels of latitude, and meridians of longitude; or a path of any width along the track of a ship or aircraft. The request will usually specify whether the message is for all ships on plot or only for those with a doctor on board.

The contents of the retrieval answer from the AMVER Center will include the ship's name and international call sign; predicted position and time of arrival thereat; course, speed, and radio watch schedule; availability of a doctor, radar, and radio telephone; and estimated time of arrival at destination.

REMARKS. The AMVER System is an excellent example of the use of modern electronic and computer technology to improve service. The computer's instant reaction to preset mathematical programs concerning ship positions is illustrative of the system's information search capability.

The computer's magnetic memory contains a list of more than 17,000 ships along with their search and rescue characteristics. Three thousand different vessels are plotted each month on 6,000 separate passages. During each month in the North Atlantic maritime region about 100 requests for Surface Pictures are acted upon by the system in resolving actual or potential emergencies.

AUTOMATED MERCHANT VESSEL REPORT (AMVER)



1. Permanent ship characteristics and rescue information processed and stored in computer's memory.

2. Specific voyage information received in message form from ports of departure and other sources.

3. Clerks transform information into coded form and convert into punched card format for entry into computer memory.

1. AMVER center's data bank includes profile information on 1,700 merchant ships and current voyage information on ship movements.

2. Request for specific information on ships in "Surface Picture" are retrieved from data bank and forwarded electrically to rescue coordination center.

3. Coordination printout copy is made for AMVER center needs.

1. Ship emergency messages relayed by receiving radio stations to appropriate rescue coordinating center.

2. Rescue center requests "Surface Picture" from AMVER center of the sea area involved.

3. AMVER center requests data processing activity to retrieve appropriate "Surface Picture" information for direct transmission to rescue center.

NAME OF SYSTEM:

Personnel Skills Inventory

ORIGINATOR:

United States Coast Guard
400 Seventh Street, S.W.
Washington, D.C. 20591

OBJECTIVE. To establish an economical and effective retrieval system to assist in the identification of personnel qualified to fill specific job requirements.

BACKGROUND. A traditional personnel policy within the Armed Forces is the reassignment of uniformed personnel to new positions upon completion of a designated period in job assignment. These job changes are necessary to equalize time spent by personnel at oversea posts or on ships away from families; to give individuals experience in a variety of assignments; and to reassign personnel to positions of greater responsibility when they are promoted.

As the base of knowledge and specialization expands, a somewhat similar pattern occurs within the services. Thus, the need to select individuals having the proper skills and other qualifications becomes a real challenge. The Coast Guard was aware of the need to increase the effectiveness of their officer assignment activity. Several rather simple index reference systems were evaluated. The optical coincidence card technique was selected as best-suited to their particular needs.

THE NEW METHOD. The Termatrex optical coincidence card system consists of a group of 9 x 9 inch opaque, plastic index term cards, a hole drilling machine, and a simple, backlighted card viewing device (light box). Each optical coincidence card represents a characteristic or attribute of significance in the determination of officer assignment qualifications. Approximately 500 cards make up the personnel skills inventory file. They are initially arranged under about 30 broad categories of interest and include such personnel characteristics or attributes as civilian education, language facility, military specialty, and past assignment data. Within each of these primary categories is a large grouping of more specific information such as year of birth, level of education, specific languages, and particular job qualifications and levels of past assignments.

The optical coincidence cards contain 100 vertical and 100 horizontal positions that total 10,000 hole positions or numerical "addresses." Each officer on active duty with the Coast Guard is assigned one of these coordinate addresses to identify his service record jacket. For example, an officer assigned the address at the intersection of vertical position 26 and horizontal position 43 would be given the coordinate number 2643 to identify his service jacket. A hole is drilled in all those cards representing an officer's service profile, at his "dedicated" address position.

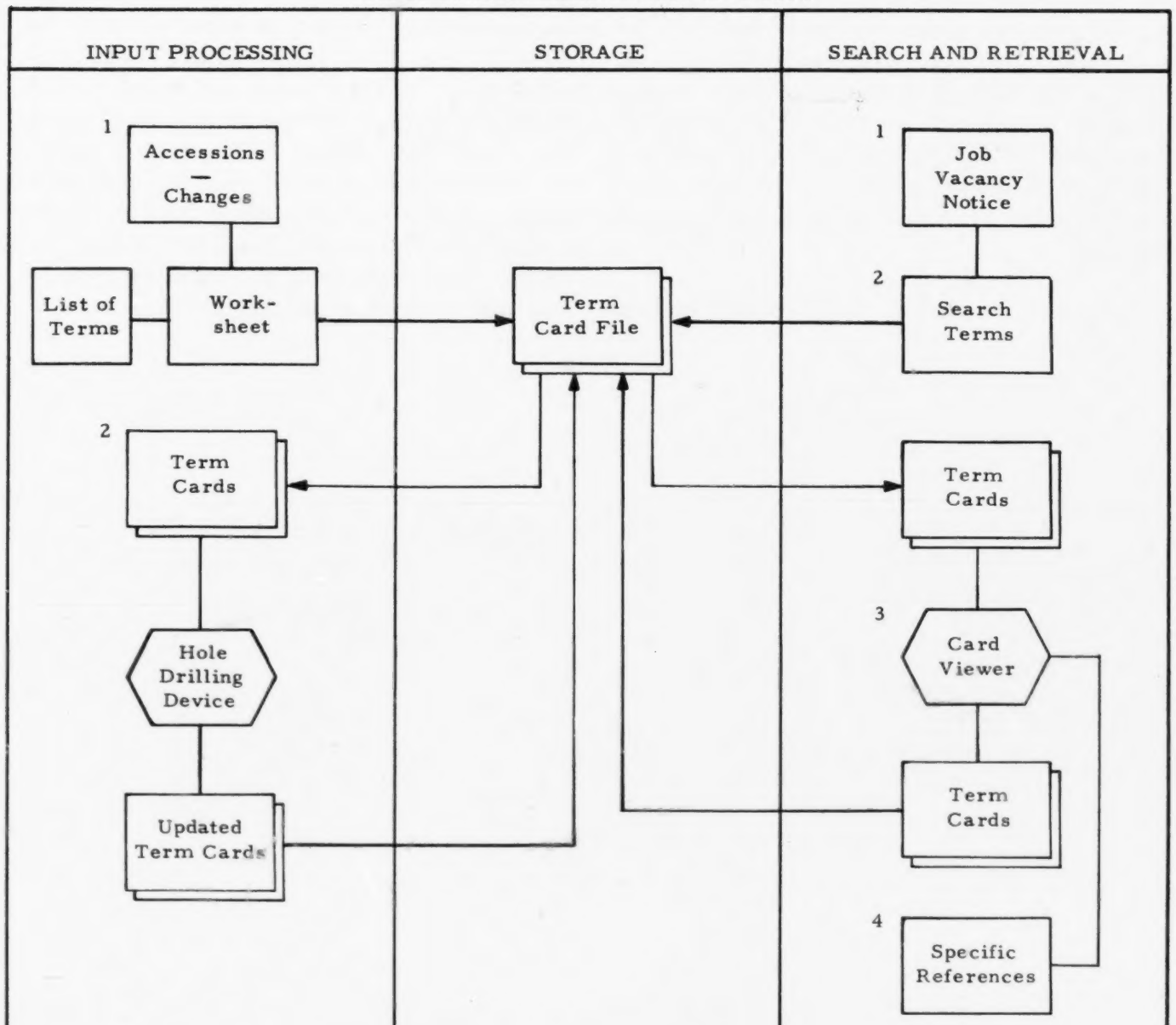
Searches are initiated upon receipt of an officer's position vacancy notice in the Coast Guard headquarters, Officers Assignments Activity. These notices list specific skills and background requirements for the forthcoming vacancy. For example, among other demands the position may call for an advanced degree in oceanography, a familiarity with Spanish, and four years experience as a navigator. A clerk handling such a requirement would first note the proper major category index tab and withdraw the cards representing those characteristics or attributes.

The selected optical coincidence cards are carefully superimposed on top of the backlighted viewer. With the light turned on, a dot of light will reveal numerical coordinates representing service record jacket numbers of officers having the desired qualifications. Should there be no coincident holes, the originator of the search may wish to change the search criteria. Within seconds, cards representing changes or compromises may be placed on the light box. At the completion of a successful search the service record documents are withdrawn from the document file for assignment action.

REMARKS. While this system's procedural applications are similar to those described in the Joint Chiefs of Staff records retrieval system, the optical coincidence card in this example represents characteristics unique to personnel job qualifications. The JCS system highlighted indexing terms associated with identification of documents by subject matter content.

This index reference and retrieval system permits rapid and flexible searches. Output is accomplished in a few minutes—only the time it takes to pull the appropriate cards, place them on the viewer, and check for co-ordinate numbers. A search question can be rephrased by adding or removing cards. While not used directly to make assignment decisions, this technique does allow the Coast Guard to maintain positive control over the initial identification and screening process relating to eventual selection.

PERSONNEL SKILLS INVENTORY



1. Information on new officers and changes to previously accessioned term cards are entered into the term card file through process of coordinate drilling of holes.

2. Term cards representing officer qualifications are returned to file.

Master term card file consists of about 500 terms. Terms cover all characteristics that are necessary to evaluate officer qualifications for vacant positions. The 6,000 officers average about 20 characteristics each.

1. Clerks isolate search terms based on job requirements.

2. Proper term cards withdrawn from file and placed on viewer for identification of qualified officers.

3. Identities of qualified personnel established through "light dot" technique.

4. Coordinate numbers representing officer service record jacket are recorded for use in withdrawing record jacket from file.

NAME OF SYSTEM:

Computer Output Data Retrieval

ORIGINATOR:

Division of Disbursement
Bureau of Accounts-Fiscal Service
Department of the Treasury
Washington, D.C. 20220

OBJECTIVE. To evaluate and operate a microform data storage and retrieval system that will result in significant tangible savings and operational improvements in the check inquiry activity.

BACKGROUND. The Division of Disbursement—one of five divisions in the Bureau of Accounts—functions as a service organization providing centralized disbursing facilities to about 1,600 civilian agency offices of the Executive Branch of the Government. Its primary mission is issuing Government checks and savings bonds. During the last fiscal year, the Division issued 425 million checks with a face value of about $100 billion. The centralized disbursement activity is carried out by 10 regional disbursement offices located throughout the United States.

A record is made of each Government check issued. This record is used as a basic source of reference in the processing of check nonreceipt claims and various types of inquiries. No other permanent record of checks is prepared or maintained. Prior to 1949, all of the disbursement check records were in the form of paper copies. These copies were costly both to produce as well as service. Storage of the records became an increasingly serious problem as did the deterioration of the paper.

To resolve this growing storage and maintenance problem, a microform system was adopted in 1950 that proved relatively effective until increasing workload again created problems in the late 1950's. After a three-year evaluation of improved methods and equipment, the Treasury Department settled on a combination magnetic tape and microfilm system. The analysis of the various system proposals was based primarily on quality, cost, and speed. One of the real breakthroughs came from the fact that magnetic tape systems were already integrated in the production of the checks. Thus, the adopted system permitted the disbursement offices to move from the high speed method of microfilming checks into an ultra-high-speed system of preparing microfilm directly from the already edited magnetic tape.

THE NEW METHOD. The computer-microfilming system, now commonly called the COM (computer output microfilm), accepts check issue data from the magnetic tape produced for the check writing function and converts the tape's binary-coded bits to human-readable characters on 16-mm. microfilm. This process is performed by a Digiprint COM recorder that displays the characters on a cathode ray tube in a frame format.

In addition to serving their own disbursement needs, the Chicago-based system duplicates microfilm records of recurring benefit payment checks for use by other administrative agencies for security backup purposes. The Chicago office also duplicates the microfilm record of benefit payment checks for 55 regional offices of the Veterans Administration (VA). This arrangement allows VA to deal personally with veterans and their dependents concerning the average of 8,000 monthly check payment problems.

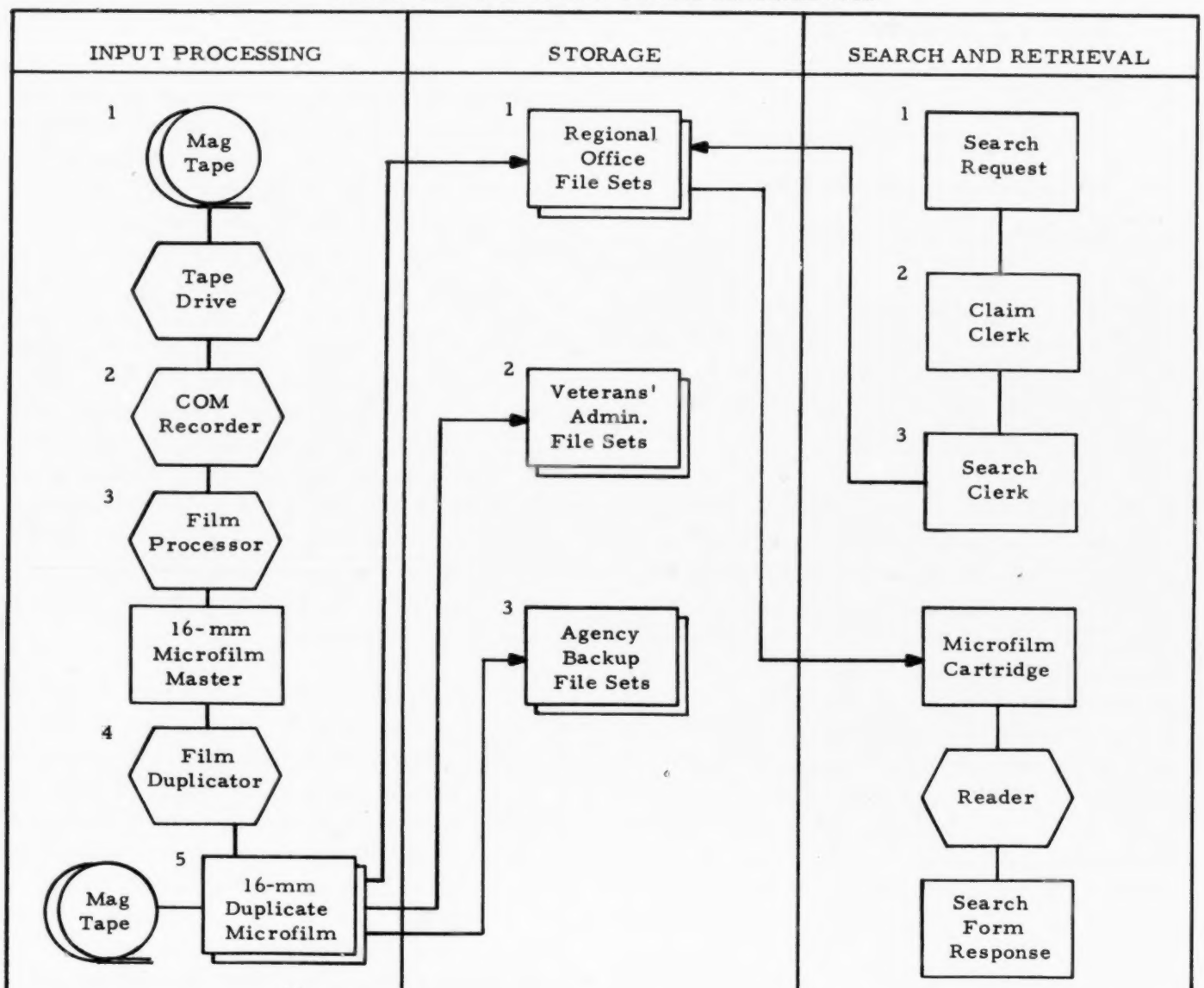
Search actions relative to check payment problems are usually generated through personal inquiry at any of the regional offices. Claims clerks receiving the query initially record all known information on a claim form that is passed to search clerks located in the microfilm file area. As check issue records are controlled by check serial number sequence, microfilm cartridges are positioned in the storage container to show their range of numbers. The searcher places the proper cartridge in the reader and, with knowledge of the cartridge's number range and the number being searched, is able to quickly bring the proper image within close proximity of the

viewing screen before making a detailed examination. Once the proper record is found, the search clerk completes the form and passes it to the claim clerk for final action.

REMARKS. The use of microfilm in the check handling function has had a profound effect on the Division of Disbursement's productivity. In 1949 one employee could, in effect, completely process about 61,000 checks per year. Currently each employee handles 299,000 checks, or five times as many. The elimination of paper check issue records in favor of microfilm and the consistent improvement in the microfilming techniques contribute substantially to this increase in productivity.

Film is now being produced at the rate of over 1½ million check record images per day. A single roll of microfilm holds 102,000 check records. From the standpoint of effectiveness, the current system enables check issue records to be produced 70 times faster than the old paper copy system permitted.

COMPUTER OUTPUT DATA RETRIEVAL



1. Check issue records data in magnetic tape format forwarded weekly by disbursement office regions to Chicago disbursement region by airmail.

2. Magnetic tape converted to readable characters on microfilm by COM recorder program.

3. Film processor produces 16-mm silver halide microfilm positive.

4. Duplicator produces microfilm negative copies which are spliced into 100 ft. rolls and placed in cartridges.

5. Magnetic tapes and duplicate microfilm cartridges are airmailed to originating offices.

1. Each of eight regional disbursement offices maintain microfilm file sets of check issue records for reference purposes.

2. Duplicate sets of check issue records pertinent to the Veterans' Administration payees are forwarded to 55 VA regional offices.

3. Additional check issue record microfilm sets are forwarded to other agencies as backup for security purposes.

1. Search requests originate with people concerned about check status.

2. Claim clerk records pertinent search data.

3. Search clerk identifies and places proper microfilm cartridge in reader and records data. Search clerk returns search form with appropriate data to claim clerk who then responds to concerned individual.

NAME OF SYSTEM:

Battelle Clue-Word Card

ORIGINATOR:

Defense Metals Information Center
Battelle Memorial Institute
Columbus, Ohio 43001

OBJECTIVE. To design and operate an index filing and retrieval system that will more effectively handle the growing mass of scholarly and scientific reference material reaching the market place.

BACKGROUND. The Battelle Memorial Institute is organized into several subdivisions known as Information Analysis Centers. Each is oriented toward research and development in such disciplines as mechanical engineering, physics, chemistry, and metallurgy. Management at Battelle found that conventional methods for classifying and indexing documents were not well-suited to the needs of the scientists, engineers, and other members of the professional staff. Consequently, after extensive research and testing, they developed their own unique system and installed it first in the Defense Metals Information (Analysis) Center.

THE NEW METHOD. The clue-word indexing technique developed by the institute's staff is a closely coordinated team effort comprising the scientists and other users, the information panel, and the center's information specialists. In the delegation of responsibilities, members of the information panel control the selection of documents to be accessioned; the method of indexing; and access to the index and file for search purposes. The information specialists have responsibility for overall operation and maintenance of the system.

The basic input action of the clue-word index technique is the underlining of significant words in the document by members of the information panel. Additionally, brackets are placed around the more significant portions of the text and illustrations. In total, this highlighted information forms an extract of the document.

While marking is a relatively simple and fast process, every effort is made to reduce the total time spent on this task by the scientists and other professional personnel who index the documents. Thus, information specialists, clerks, and typists do most of the routine work such as preparing duplicating stencils for the 5 x 8 inch clue-word extract cards. The Information Center personnel also add the document's control number and other standard identifying data. The extract card file is arranged alphabetically by the clue-word index terms. Each time a document is entered into the system, a sufficient number of extract cards are duplicated to permit filing a card under each of its underlined index terms and a few standard headings such as title and author's name.

Under actual search conditions a scientist normally answers most of his search needs by personally referring to the clue-word index with its key terms and extracts. Should he desire additional information, the referenced document may be obtained from the Central File. Typically, he starts the search by looking at the cards filed under the index term that he feels is the most pertinent to his search question. If this does not produce the desired results, he then looks for clues or leads in the form of other underlined words appearing in the extract, and thus is lead to other parts of the card file until he finds the information he is seeking.

REMARKS. Two of the more favorable benefits obtained from this system are the richness of material uncovered and the ease in indexing due to the close association that the scientists and other users have with the indexing and document selection processes.

The system's wide search versatility and latitude permit searchers to locate clue-word cards for as many pertinent documents as they wish. Thus, a search can be shallow or exhaustive, depending on the user's needs. There is also a high degree of relevance in

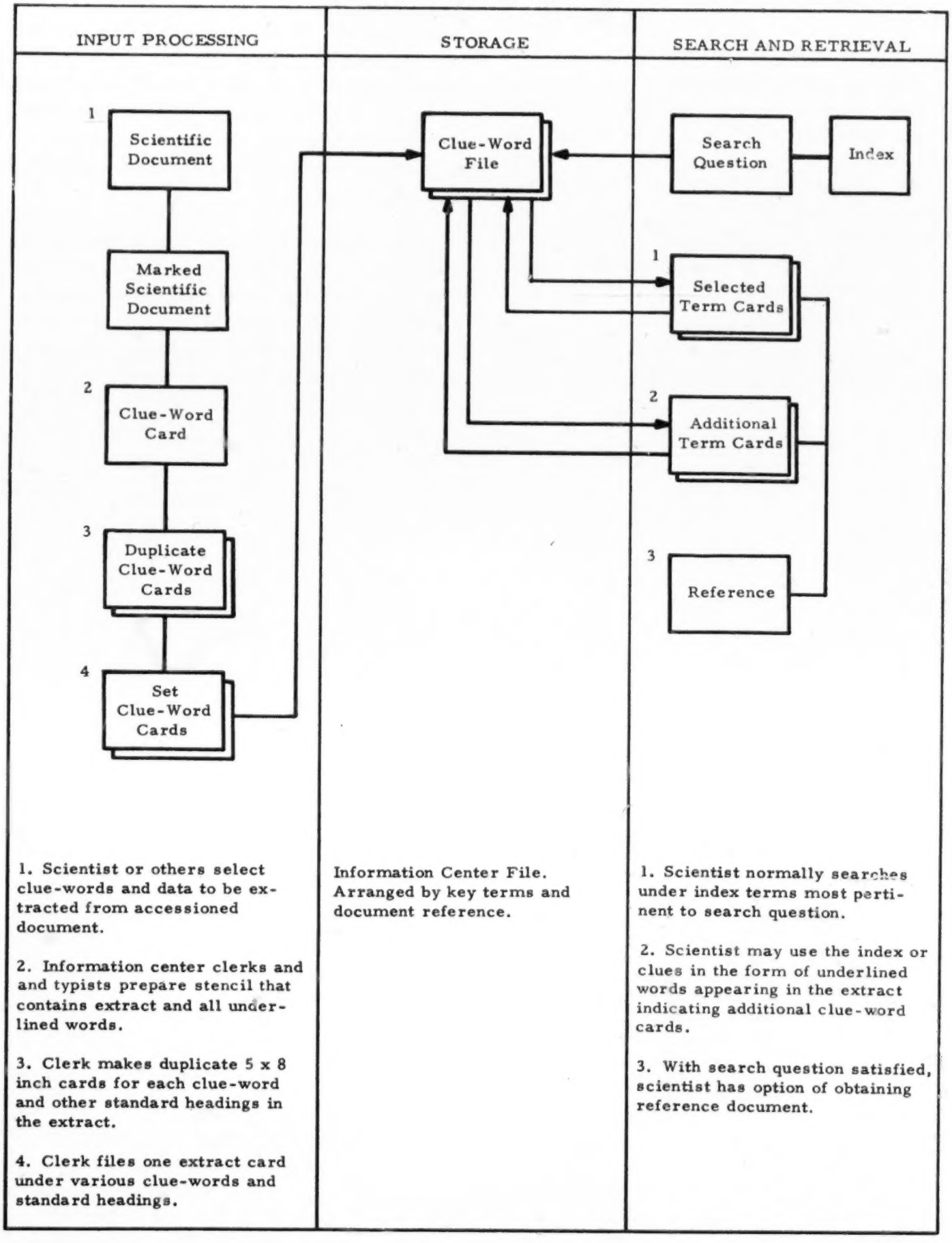
data retrieved due to the concentration of meaningful information on each clue-word extract card.

The system is actually very simple, yet highly effective in terms of results. However, some limitations should also be noted: (1) the relatively slow filing action due to the large number of index cards required per document; and (2) the effectiveness of this type system is largely dependent upon the existence of close cooperation and understanding between the users and the operators of the system.

The searching of the clue-word extract card file is susceptible to automatic searching by computer, and thus under certain circumstances the clue-word system may be a satisfactory substitute for the more expensive full text indexing systems. Officials of Battelle have developed a proposal to utilize a computer for searching, but it will be necessary to convert the present clue-word extract cards to machine-language format before proceeding with the project.

Anyone starting a clue-word system at this time should give serious consideration to capturing the index data in machine language, possibly as a by-product of the typing operation, since some type of machine processing would probably be desirable later.

BATTELLE CLUE-WORD CARD



1. Scientist or others select clue-words and data to be extracted from accessioned document.

2. Information center clerks and and typists prepare stencil that contains extract and all underlined words.

3. Clerk makes duplicate 5 x 8 inch cards for each clue-word and other standard headings in the extract.

4. Clerk files one extract card under various clue-words and standard headings.

Information Center File. Arranged by key terms and document reference.

1. Scientist normally searches under index terms most pertinent to search question.

2. Scientist may use the index or clues in the form of underlined words appearing in the extract indicating additional clue-word cards.

3. With search question satisfied, scientist has option of obtaining reference document.

NAME OF SYSTEM:

Battelle Dual Dictionary Index

ORIGINATOR:

Radiation Effects Information Center (REIC)

Battelle Memorial Institute

Columbus, Ohio 43001

OBJECTIVE. To design and develop a simple yet effective coordinate indexing system that will enable the hundreds of users to conduct their own searches.

BACKGROUND. The Radiation Effects Information Center, one of Battelle Memorial Institute's many technical information analysis groups, investigates such scientific areas as radiation effects on humans, on space travel, and on various metal devices. This dynamic and expanding area of science, with its many new discoveries, prompts the writing and circularization of a considerable volume of literature.

Since its inception in 1957, REIC has been offering a "current awareness service" to its many sponsors such as the Air Force, the National Aeronautics and Space Administration, the Atomic Energy Commission, and numerous contractors and subcontractors. As part of this service, each sponsor is sent a monthly announcement of the documents accessioned during the prior month. These announcements include such information about the document as the title and author and an abstract or extract of the information.

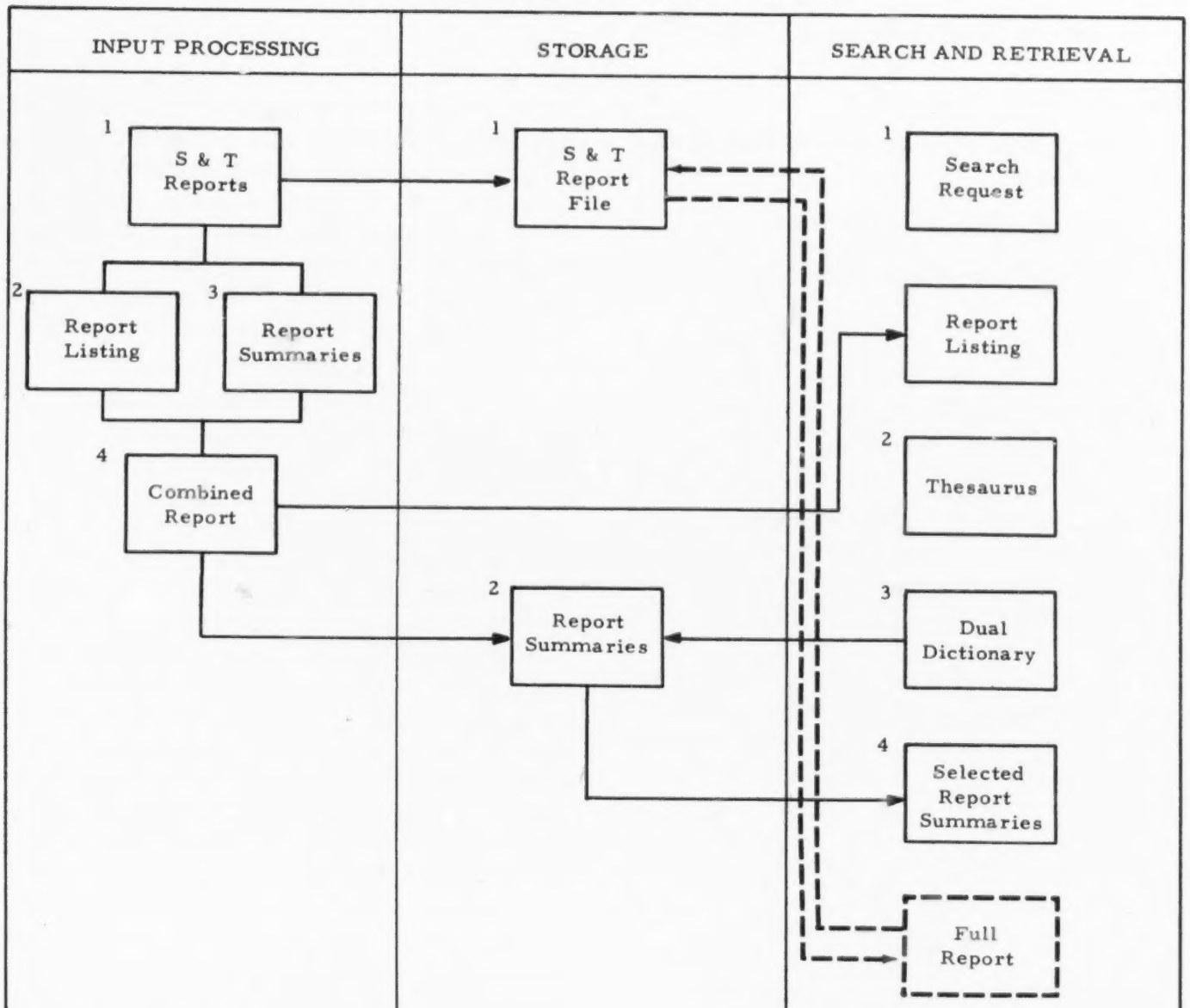
To assist the users in assimilating this vital information and in conducting their own searches, a simple, inexpensive, and comprehensive dual dictionary (or index) system was developed.

THE NEW METHOD. The dual dictionary system is similar to the columnar card system except that the index postings are listed on pages instead of individual cards. The dual dictionary consists of two identical sets of page listings, each a half-page wide and mounted side-by-side on a stiff backing sheet with a plastic ring binding at the top. Each side consists of a listing of all the indexing terms used in the system. Below each term are ten columns (final digits 0 through 9) of numbers identifying those documents that were assigned that particular term during the indexing process. Normally, each document is assigned more than one term. A copy of the Information Center's thesaurus of about 1,000 entries is attached at the back of the dictionary.

To conduct a search of the dual dictionary, the user must first determine which terms best describe his search question. He then locates his first term on one side of the dual dictionary and keeps that side opened to that page. Next, he looks up the second term in the opposite side of the dictionary and compares the document numbers, column-by-column, for matching numbers. Taking note of any matching (coinciding) numbers for these two terms, he again turns the pages on the opposite side to the next indexing term involved in the search to see if there is a further match. This process is repeated until all numbers under all the terms used in the search have been checked. The numbers that appear under all the indexing terms searched identify those documents that contain the answer to the search question. The searcher may refer to the abstract or extract contained in the monthly document announcement bulletin for a description of the document.

REMARKS. The dual dictionary system reduces the workload at the Battelle Information Center by providing each sponsor-user with a broader search capability. This capability permits them to handle many of their more routine information needs, thus reducing their reliance on the facilities of the Information Center. It also gives the searcher the opportunity to frame his search request in a wide variety of ways, thus permitting him to tailor the search to satisfy his particular needs and experience. The mechanization of the updating, together with the computer printout capabilities, assures faster announcement of newly accessioned material.

BATTELLE DUAL DICTIONARY INDEX



1. Scientific and technical reports selected for accessioning by Battelle Information Center. 2. Report titles are listed and catalogued. 3. Reports are summarized as abstracts or extracts. 4. Combined report is forwarded to subscribers throughout the country.	1. Original S & T reports are filed at Battelle Information Center. 2. Subscriber-searcher checks his report summary file for specific abstracts or extracts.	1. Subscribers search accession list for broad areas of interest. 2. Thesaurus is checked to assist in formulating search terms. 3. Dual dictionary reveals identity of articles fulfilling broad search terms. 4. Selected summary reports usually answer searcher needs. Full report may be obtained if necessary.

NAME OF SYSTEM:

Aircraft Maintenance Manual Distribution and Updating

ORIGINATOR:

Eastern Airlines

Miami Maintenance Base, Miami International Airport

Miami, Florida 33848

OBJECTIVE. To develop and operate a company-wide aircraft maintenance information storage, retrieval, and display system that is better suited to the needs of the maintenance facilities; also, to reduce costs and elapsed time for reproducing, distributing, and updating manuals.

BACKGROUND. What began long ago as a fairly simple operation—the provision of maintenance manuals for aircraft operated by commercial airlines—today has grown as much in complexity as the aircraft themselves. From a book about the size of a modern automobile maintenance guide, these aircraft manuals have grown to enormous sizes. To illustrate, until recently it took as many as 7,000 manual pages to properly document all the engineering and maintenance details for just one type of jet aircraft. In total, the full Eastern Airline's fleet of over 250 aircraft required about 150,000 pages of technical instructions. To keep the documents current throughout the Airline's network of about 70 locations, over four million inserted changes were made in 1965. Because of this constantly expanding bulky file of information and the impending addition of three new types of aircraft to the fleet during the following three years, Eastern Airlines began studying the unique qualities of microform for solving the problem.

The company desired a microfilm system that would present the manual information in an easily accessible manner, both for mechanics and inspectors working on the line, as well as for people responsible for entering procedural and technical changes. They felt that any new system should have the capability of providing the line mechanic with specific pages covering a particular assignment.

An in-depth study of the problem resulted in the adoption of a system that utilized the best features of systems developed by three major microform manufacturers. The company believes that this system should satisfy their maintenance information handling needs for many years to come.

THE NEW METHOD. The adopted system requires the maintenance of only one master aircraft maintenance manual, kept in paper form at Miami, for each aircraft type. One person is assigned the responsibility for keeping the master copy up to date. This conventional master manual is periodically recorded in 16-mm. silver halide microfilm through use of two types of film cameras. A B–H rotary (automatic) camera is used for filming of normal text, while a Recordak planetary or overhead camera is used for the detailed wiring diagrams and other high resolution tasks.

The film is developed in a Sepratron processor. Approximately 100 diazo negative roll microfilm copies are then produced on a CBS (Columbia Broadcasting System) continuous film duplicator for distribution to about 70 primary aircraft maintenance facilities throughout the EAL network and elsewhere. An index is prepared for use with a Filmac Model 400 cartridge roll microfilm reader-printer that uses the odometer technique for image finding. The microfilm copies are loaded into cartridges and index labels are placed on the outside. The complete manual sets, usually consisting of three cartridges for each type of aircraft, are placed in special shipping containers used for distribution of the new microform copies and for return of the old copies to Miami; thus, the cartridges are used over and over again.

The user's microfilm cartridges are stored in a special receptacle located close to the reader-printer. The user—a mechanic, an inspector or supervisor—has the option of viewing the page image on the reader or of obtaining a disposable enlarged paper copy for

use in his work location. As a safety factor, the paper copies are self-erasing within 60 days.

Microform copies are also distributed for use on portable readers kept at secondary locations, such as on board aircraft involved in EAL off-system operations. These readers operate on aircraft, motor vehicle, or self-contained battery power. The microform manual file and reader for this secondary use are contained in a single package weighing about 14 pounds and about the size of a portable typewriter, in contrast to the 80-pound weight of a set of paper manuals.

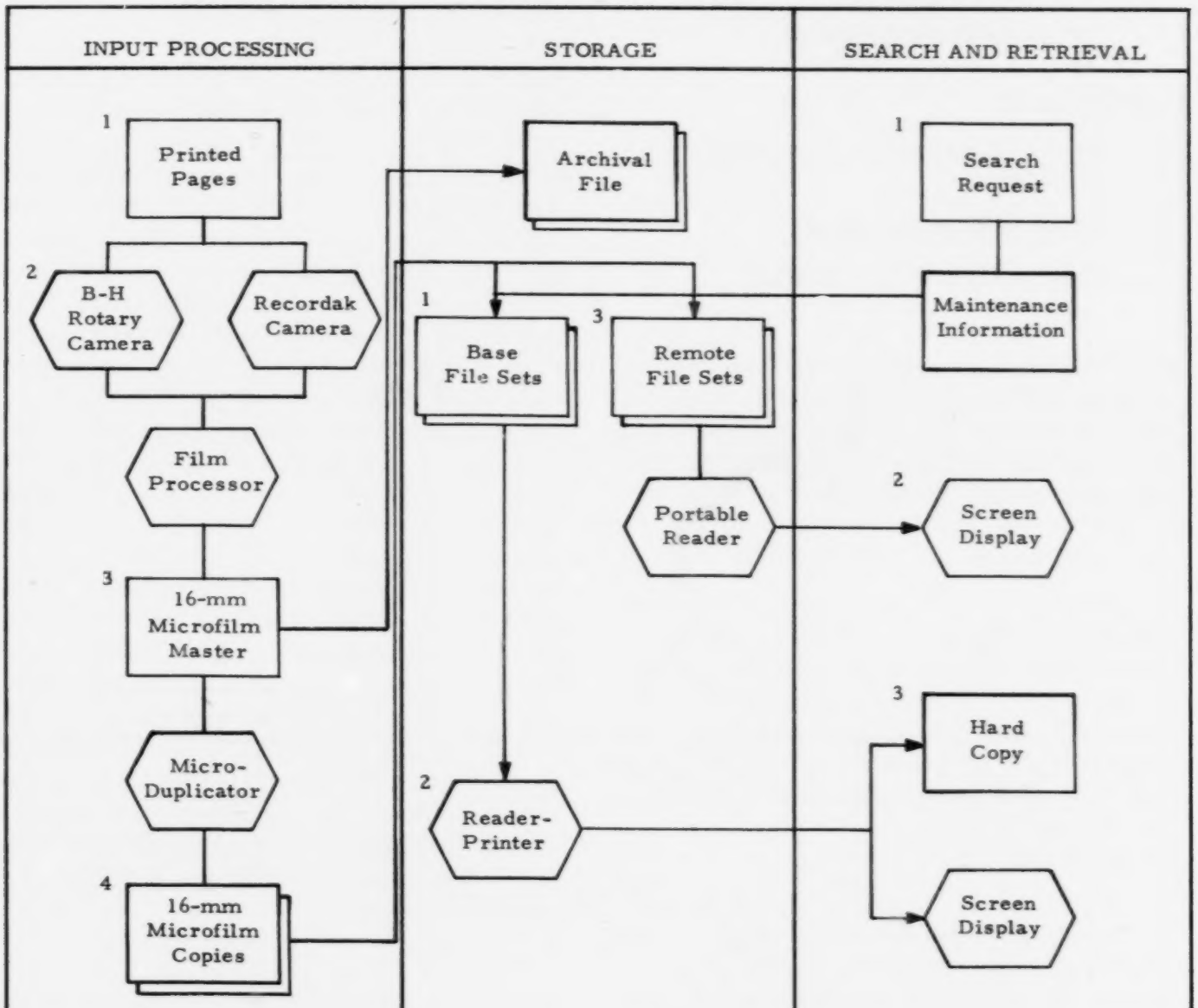
New information of importance received between each month's file updating is handled by teletype messages or through use of temporary paper revisions, which are filed in a binder adjacent to the viewer equipment. Careful control keeps this supplemental paper to a minimum, and it is destroyed upon receipt of the completely updated microform copy.

REMARKS. One of the problems generally associated with the distribution of technical information is that of file integrity. However, under this system excellent file integrity is assured due to the specially maintained single master paper copy. Formerly, about 75 people throughout the Eastern Airline network had some responsibility for maintenance of the aircraft manuals.

Due to elimination of the time consuming mass paper printing, packaging, and shipping processes and the close cooperation between the airline and the many aircraft manufacturers, the time required to provide current information to the many maintenance facilities has been greatly reduced. The new system has reduced the former space requirement of a 12-foot shelf of books to a reference file about the size of a shoe box.

In summary, in addition to the tangible benefits in the form of savings in personnel, handling, storage, and other costs, this system has resulted in greatly improved quality control; greater flexibility in file location and display methods; and earlier receipt of the latest technical changes at the using locations.

AIRCRAFT MAINTENANCE MANUAL DISTRIBUTING AND UPDATING



1. Maintenance manual. Printed pages originate with E.A.L. or [illegible] manufacturers.

2. Pages of information are photographed and processed on silver halide 16-mm microfilm.

3. About 100 duplicate diazo copies are made for use by maintenance stations and secondary locations. Master microfilm is placed in archival file.

4. Microfilm copies are cut into 100 ft. lengths, indexed, and placed in cartridges. File sets are shipped to user locations.

1. File sets of microfilm versions of maintenance manuals are used at about 70 locations. Each set covers information on each type of aircraft operating in the system.

2. Each location uses reader-printers for displaying information on reader screen or on produced hard copy.

3. Remote file sets are located outside office or shop area. Information is displayed on portable reader screen.

1. Information is generally used by maintenance and inspection personnel.

2. Users in remote locations obtain information on portable reader screen.

3. User has option of obtaining a visual image on screen or hard copy that can be discarded after use.

NAME OF SYSTEM:

ZIP Code Data Retrieval

ORIGINATOR:

National Education Association (NEA)

1201 16th Street, N.W.,

Washington, D.C. 20036

OBJECTIVE. To evaluate and select a data retrieval system that will provide a fast and efficient method for looking up postal ZIP Codes so that they may be added to the mailing addresses of Association members. Also, to provide a simple, inexpensive method for updating data in the ZIP Code directory.

BACKGROUND. The National Education Association (NEA) represents the professional interests of about one million teachers in the United States. The advent of the ZIP Code and the requirement for bulk mailers to add geographical code elements to each mailing address created data retrieval problems for the NEA.

Their initial need was to determine the best method for retrieving ZIP Code information for inclusion on the NEA master mailing list. The basic method for accomplishing this task was the Post Office Department's bulky, 1,800 page National ZIP Code Directory. Its page format comprises five columns of alphabetically arranged listings of States, cities, towns, and streets, with ZIP Codes shown for each entry.

The manual Directory search routine consisted of finding the member's State, followed by an alphabetical rundown of the State's city or town, and finally the street address. The ZIP Code would then be noted on the member's master address card. To alleviate this tedious and time consuming method of finding and posting ZIP Codes for over a million members, the NEA study group recommended adoption of the ZIP Code Data Retrieval System employing microfilm strips.

THE NEW METHOD. Initially, the NEA converted the ZIP Code Directory to a magnetic tape format and arranged for a commercial firm to convert the magnetic tape information into 16-mm. microfilm through use of COM (computer output microfilm) equipment. This action was taken in conjunction with a program to mechanize the overall mailing list operation. The 16-mm. rolls of microfilm were photographed and developed, and the film was spliced into 12-inch strips, each containing 12 pages of ZIP Code information. Film strips were then mounted on plastic strip holders measuring about 14 inches long and indexed to reflect the proper geographical area. A visual index label located on the front of each plastic strip holder indicates the State to which the contained microfilm information applies. Color coding is added for ease of identification when a States's listings overlap into additional strip holders. Located on the back of each strip holder is a second and more precise index listing showing city, town, and street information, which is only visible when the holder is removed from the data file. The full ZIP Code inventory comprises 200 visible strip holders housed in a 200 slot "honeycomb" file container easily accessible to the searcher and viewing equipment.

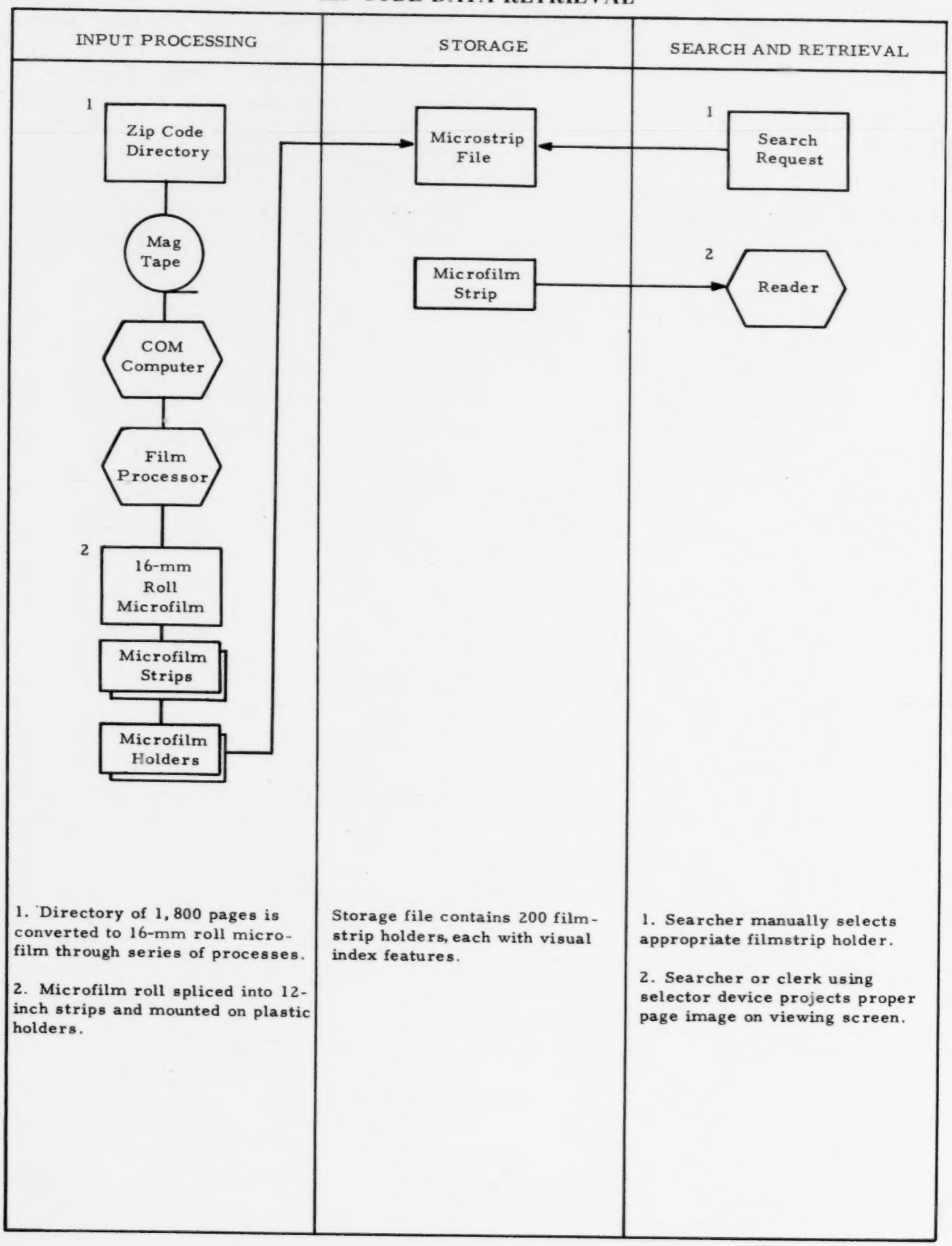
A search of the ZIP Code data file aimed at finding the ZIP Code applicable to a known address would first involve selection of the State and particular city by noting the visual index information. The selected strip holder is then manually placed in a slotted keyway on the microstrip reader. The placement of the strip holder on the reader exposes the secondary index that lists more precise information concerning street identities and microfilm strip page numbers. With the page number determined, a mechanical pointer within the system is manually positioned next to the proper page number. This action causes the page image to show on the reader screen and the searcher then matches the known street address with its proper ZIP Code identity. The search task is completed when the searcher records the ZIP Code next to the rest of the address.

REMARKS.[1] This type system has been primarily used for storing and retrieving information and data contained in listings such as catalogs, directories, and inventory lists. The basic equipment is commercially marketed but is not compatible with other microform systems.

The one-time conversion of original listings to microstrip form can be a costly operation, but it results in a greatly improved information updating and retrieval operation. In addition, there are frequently other reasons why it may be advantageous to convert such listings to machine-language format, and once this is accomplished, the microstrips can be produced at a relatively low cost through COM (computer output microfilm) equipment. In the case of ZIP Code information, the user can obtain and update the microstrips for a small monthly service charge.

[1] The National Education Association found that the microfilm strip system provided its greatest benefits during the initial conversion of the mailing lists to include ZIP Code entries.

ZIP CODE DATA RETRIEVAL


INPUT PROCESSING
STORAGE
SEARCH AND RETRIEVAL
1
Zip Code Directory
Mag Tape
COM Computer
Film Processor
2
16-mm Roll Microfilm
Microfilm Strips
Microfilm Holders
Microstrip File
Microfilm Strip
1
Search Request
2
Reader
1. Directory of 1,800 pages is converted to 16-mm roll microfilm through series of processes.
2. Microfilm roll spliced into 12-inch strips and mounted on plastic holders.
Storage file contains 200 filmstrip holders, each with visual index features.
1. Searcher manually selects appropriate filmstrip holder.
2. Searcher or clerk using selector device projects proper page image on viewing screen.

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